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Abstract

Dietary Intake of Pregnant Women and Its Association with Cardio-Metabolic Risk in Their Children [†]

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Abstract: Maternal nutritional status during pregnancy affects the growth of the foetus and may impair the development of different organs, some of which may affect cardio-metabolic health in early childhood. This study determined the dietary intake of pregnant women and its possible associations with early child cardio-metabolic risk. **Methods:** Dietary data were collected from 152 of a larger sample of 500 pregnant women and their children at birth and at the age of 5–6 years within the Tygerberg Academic Hospital catchment area, Bellville, South Africa. Maternal weight, height, BMI and mid-upper arm circumference were collected at recruitment. Birth weight, length, head circumference and placental weight were collected at birth. At the age of 5–6 years, anthropometric measurements (weight, height, skinfold thickness and waist circumference), clinical measurements (blood pressure, mean arterial pressure and heart rate) and ultrasound measurements (pancreas, aorta, carotid arteries and visceral fat) were collected. For the purpose of this abstract, we will report only on the ultrasound measurements for vascular and pancreas parameters. Dietary data were collected using a quantified food frequency questionnaire. **Results:** Iron intake did not differ significantly between the trimesters, nor between mothers who smoked (14.5 mg), consumed alcohol (16.5 mg) or both (15.0 mg). The average total energy intake of mothers was 10,850 kJ (SD = 3001 kJ), which was slightly above NIH recommendations. Most of the energy came in the form of saturated fat, oils and added sugar. Both protein and carbohydrate intake exceeded recommendations, with average intakes of 82 g and 275 g, respectively. Folate intake was below recommendations at 287 mcg. A significant association was found between maternal carbohydrate intake and the size of the pancreas body (0.164; $p < 0.05$) as well as between protein intake and aorta intima media thickness ($r = 0.201$; $p < 0.05$), while a negative association was found between polyunsaturated fat intake and left carotid intima media thickness (-0.179 ; $p < 0.05$). **Conclusions:** Dietary intake in this group did not indicate nutritional deficiencies. However, the low folate intake may be of concern. The association of fats with vascular wall thickness and the association of carbohydrate intake with increased pancreas size needs further investigation.

Keywords: dietary intake; pregnancy; children; ultrasound; pancreas; aorta; carotid arteries; alcohol; smoking

Author Contributions: Conceptualisation, A.O., H.O. and J.D.S.; Methodology, A.O., J.D.S. and H.N.; Software validation and formal analyses, J.D.S., L.B. and D.N.; Writing original draft preparation, A.O.; Writing review and editing, A.O., H.O. and J.D.S.; Supervision, A.O., H.O. and J.D.S.; Funding acquisition, H.O. and J.D.S. All authors have read and agreed to the published version of the manuscript.

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Abstract

Effect of Obesity Prevalence on Vitamin C Intake Requirements [†]

Julia K. Bird ^{*}, Edith J. M. Feskens [†] and Alida Melse-Boonstra [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Dietary requirements for vitamin C in age and gender groups are based on body weight. Mean body weight has increased since the requirements were set due to the increase in obesity prevalence. How does dietary adequacy change if the

requirements are adjusted for current mean body weight? NHANES 2017–March 2020 survey data were obtained. Participants with complete demographic, dietary and body measures data were included ($n = 12,409$). Mean body weight was obtained for men and women, which was used to calculate the EAR according to the method used by the Institute of Medicine. Dietary adequacy was assessed according to the current and adjusted Dietary Reference Intakes (DRIs), using the Statistical Program for Assessing Dietary Exposure (SPADE) to obtain habitual intakes. Dietary intakes from food and dietary supplements were used. Using the current mean body weights for men and women, the DRIs increased from 75 to 85 mg per day for men and from 60 to 75 mg per day for women. When assessed against the current requirements, 42% and 33% of male and female participants, respectively, did not meet the EAR. With the adjusted requirements, 47% and 43% of male and female participants, respectively, did not meet the EAR. In the age/gender groups most at risk of inadequate intakes (adult men aged 19–30 and 31–50), the prevalence of inadequate intakes below the EAR increased from 59% and 52%, to 65% and 59% with the adjusted DRIs. The habitual intake analysis showed that when DRIs are adjusted linearly for increases in body weight due to obesity, the prevalence of inadequate intakes increased over the US population. For men aged 19–30 and 31–50, who are at the greatest risk of inadequate intakes, the increase in body weight further increases the proportion with inadequate intakes. This age/gender group shows the highest prevalence of biochemical deficiency and should be a focus of nutritional interventions to improving intakes. Assessment of the relevance of current DRIs in light of increased body weight due to a greater prevalence of obesity should be undertaken.

Keywords: obesity; dietary requirements; vitamin C

Author Contributions: Conceptualization, J.K.B.; methodology, J.K.B.; formal analysis, J.K.B.; writing—original draft preparation, J.K.B.; writing—review and editing, A.M.-B. and E.J.M.F. All authors have read and agreed to the published version of the manuscript.

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Dietary Studies, Guidelines and Recommendations: Limited Nutrient Deficiency Risks and Significant Modelled Health Benefits in French Adults Following a More Plant-Based Diet [†]

Pauline Mombert ^{1,*} , Jean-François Huneau ¹, Juhui Wang ¹, Jeanne-Marie Membré ² and François Mariotti ¹ 



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Abstract: There is a current trend towards plant-based diets in Western countries. These diets have been associated with long-term health benefits but could limit the adequacy of some indispensable nutrients. Here, we estimated the nutritional risks and health benefits of consuming more plantbased diets. Based on the latest French representative survey (INCA3), we defined a subgroup of adults (representing 12% of the population) with more plant-based diets (“MORE-PB”), defined as having plant protein and plant energy intakes above the 80th percentile. In the MORE-PB and the rest of the population, we estimated prevalences of nutrient inadequacy and deficiency risk. We also assessed the nutrient quality of the diet using the PANDiet and SecDiet scoring systems. Finally, we evaluated the hypothetical burden of disease if the entire population were shifting to the MORE-PB, using a comparative risk assessment framework (EpiDiet). In MORE-PB, we found a lower prevalence of inadequacy for fiber (both sexes), vitamin C (male), vitamin B9 and potassium (female) and a higher prevalence for vitamins B2 and B12 (both sexes), vitamin B6 (male), and protein (female). No differences were found concerning the prevalences of deficiency risk. No significant differences were observed in the PANDiet and SECDiet scores in MORE-PB compared to the rest of the population. Regarding nutrient intakes related to long-term health, MORE-PB were less prone to exceeding upper limits for SFA but more prone to exceeding those for sugars and sodium. Shifting to a MORE-PB would benefit population health, with ~132,700 [~125,400–~140,000, 95% UI] Disability-Adjusted Life Years (DALYs) averted. The gain would be higher for males than females (~92,000 vs. ~40,700 DALYs averted) but related to the same main diseases (ischemic heart diseases, diabetes and colorectal cancer). The decreases in processed meat and SFA in the plant-based diet were among the main contributors to its benefits. Other significant contributors were higher nuts consumption and mediation by lower blood cholesterol in females and higher fruit consumption and fiber intake in males. Overall, although diet quality was suboptimal in MORE-PB, significant nutritional risks were limited, particularly concerning deficiency risk. In contrast, such diets would benefit the population’s long-term health.

Keywords: plant-based diets; risk and benefit assessment; nutrient adequacy; comparative risk assessment; DALYs

Author Contributions: Conceptualization, P.M., F.M., J.-F.H. and J.-M.M.; formal analysis, P.M., F.M. and J.-F.H.; investigation, P.M. and J.W.; writing—original draft preparation, P.M.; writing—review and editing, P.M., F.M., J.-F.H. and J.-M.M.; supervision, F.M., J.-F.H. and J.-M.M. All authors have read and agreed to the published version of the manuscript.

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Is the Generation of Active Vitamin B6 Dependent upon Riboflavin Status? New Analysis of Data from RCTs of Riboflavin Supplementation [†]

Ryan Barlow ^{1,*}, Helene McNulty ¹, Catherine Hughes ¹, Kristina Pentieva ¹, Geraldine Horigan ¹, Yvonne Lamers ² and Mary Ward



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Abstract: Background and objectives: Riboflavin in the form flavin mononucleotide (FMN) acts as a cofactor for the pyridoxine phosphate oxidase required to generate pyridoxal 5'-phosphate (PLP), the active form of vitamin B6 in tissues. Few human studies have investigated this metabolic interaction between riboflavin and vitamin B6. The primary objective of this study was to examine the response of plasma PLP to riboflavin supplementation in individuals with the *MTHFR* 677TT genotype. A secondary objective was to consider whether the dose of riboflavin (1.6 mg/d vs. 10 mg/d) affects the PLP response. Methods: Data from four randomised controlled trials (RCTs) of riboflavin supplementation previously conducted at this centre were accessed to identify 209 participants of 19–60 years meeting the inclusion criteria (≤ 60 years, *MTHFR* 677TT genotype, not taking a vitamin B6 supplement). In the original RCTs, participants were randomly assigned to receive a placebo ($n = 85$) or 1.6 mg/d of riboflavin ($n = 87$) for 16 weeks. In one trial only, a higher riboflavin dose, 10 mg/d ($n = 37$), was administered. Plasma PLP was measured via reversed phase HPLC with fluorescence detection. Riboflavin status was assessed using the functional assay, erythrocyte glutathione reductase activation coefficient (EGRac). Results: riboflavin supplementation resulted in a decrease ($p < 0.001$) in the mean EGRac values, from 1.34 (1.32, 1.37) to 1.21 (1.19, 1.22). Correspondingly, PLP increased ($p = 0.027$), an effect driven by those with a sub-optimal riboflavin status at baseline (EGRac > 1.26), whereby PLP increased by 5.2 nmol/L, from 44.9 (40.3, 49.4) to 50.1 (44.6, 55.6) nmol/L ($p = 0.042$), while with the optimal baseline riboflavin (EGRac ≤ 1.26), there was no significant PLP response to the intervention. Although 10 mg/d vs. 1.6 mg/d of riboflavin resulted in a greater EGRac response ($p = 0.012$), there was no significant effect of riboflavin dose on the PLP response. Discussion: These results provide randomised trial evidence that optimising riboflavin status leads to an increase in plasma PLP, confirming the metabolic dependency of vitamin B6 on FMN. The findings indicate that riboflavin intake may need to be considered when setting dietary recommendations for vitamin B6 in adults. Further work is needed to explore the impact of the common *MTHFR* C677T polymorphism of the interrelationship of these B vitamins.

Keywords: riboflavin; vitamin B6; pyridoxal 5'-phosphate; one-carbon metabolism

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the manuscript. All authors critically revised drafts of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Evaluation of the Quality Protein and the Effect on Muscle Health of a New Ingredient Based on Hydrolyzed Egg White [†]

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Abstract: Concerns about the growing human population and how to supply future nutritional needs have translated to a growing interest in searching for alternative proteins. However, one important aspect of protein intake to be considered is the quality of these proteins and the health benefits of these products. This a comparative study of a novel technological protein ingredient based on “hydrolyzed egg white” with different protein sources, such as pea protein, soy protein, and powder milk, evaluating the protein digestibility-corrected amino acid scores (PDCCAs) and their effects on muscular metabolism. PDCCAs are a method of determining the quality of a protein based on both the amino acid requirements of humans and their ability to digest it. An in vitro methodology has been used based on gastrointestinal digestion using a dynamic system to study the bioaccessibility of the amino acids and peptides and determine the PDCAAS, and a further study was carried out with the bioaccessible fraction in a cellular model of muscular cells (C2C12) to monitor the effect on the genes that code to myogenin, mTOR, and creatin kinase gene via rt-PCR. The results showed that the new hydrolyzed egg white-based ingredient is a high-quality protein source because the PDCAA score of all essential amino acids was higher than 1. This pattern of PDCCAs was similar to that of pea protein and slightly higher than that of concentrated soybean protein. In addition, the new ingredient in hydrolyzed egg white stimulated muscle metabolism by enhancing mTOR and myogenin gene expression in C2C12 cells. A new protein ingredient based on egg white has been developed with a proven protein quality and a healthy effect on muscle metabolism that improves protein synthesis. This new ingredient has potential in the formulation and development of new products for populations with special protein requirements, such as elderly or sportive populations, among others.

Keywords: muscle; protein; egg; health

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Fruit and Vegetable Intake and Cardiovascular Disease in the UK Biobank: The Role of Confounding [†]

Fiona MacLean *, Eirini Trichia, Timothy Key and Jennifer Carter



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Abstract: Objectives: Fruit and vegetable (FV) consumption has been inversely associated with cardiovascular disease, but questions remain about the extent to which these results are

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due to confounding. Methods: From 2006–2010, >0.5 million adults aged 40–69 were recruited to the UK Biobank. Participants free from ischaemic heart disease (IHD) or stroke, with complete information on key covariates, were analysed (n = 452,760). Usual FV intakes were measured by frequency questionnaire, categorised into four groups, and calibrated with a 24-h dietary assessment. Multivariable Cox regression was used to estimate the associations of fruit and/or vegetable intake with IHD, ischaemic stroke, and haemorrhagic stroke, adjusted for socioeconomic status, lifestyle factors, dietary factors, and body mass index. Sequential change in likelihood ratio (LR) χ^2 was used to quantify the contribution of covariates to model fit. Results: During 12–16 years of follow-up, there were 15,746 IHD events, 5940 ischaemic strokes, and 2154 haemorrhagic strokes. Associations were mostly non-linear. The lowest IHD risk was with the third category of fruit intake (median 216 g/day, HR 0.93 (95% confidence interval 0.90 to 0.97)) and second category of vegetable intake (158 g, 0.95

(0.93, 0.98)). Only the third category of fruit intake and combined FV intake were associated with a lower ischaemic stroke risk (216 g, 0.93 (0.88, 0.99) and 375 g, 0.92 (0.86, 0.97) respectively). Only the highest category of fruit intake (293 g, 0.87 (0.78, 0.98)) and second category of vegetable intake (158 g, 0.89 (0.83, 0.96)) were associated with a lower haemorrhagic stroke risk. Full adjustment reduced the LR χ^2 of associations with ischaemic disease by 87–92% and haemorrhagic stroke by 66–70%. For IHD and ischaemic stroke, the biggest reductions were with the addition of lifestyle factors in models of FV or fruit intake and socioeconomic status for vegetable intake. Discussion: The relationship between fruit and/or vegetable intake and these cardiovascular outcomes is heavily confounded by socioeconomic, lifestyle, and dietary factors. Residual confounding may explain more of the remaining association. Therefore, caution should be exercised when estimating the burden of disease attributable to low fruit and vegetable intake.

Keywords: fruit; vegetable; cardiovascular disease; UK Biobank; confounding; prospective cohort

Author Contributions: Conceptualization and methodology, F.M., E.T., J.C. and T.K.; software, Stata 18.0.; formal analysis, F.M.; data curation, F.M.; writing—original draft preparation, F.M.; writing—review and editing, F.M., E.T., J.C. and T.K.; supervision, E.T., J.C. and T.K. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The UK Biobank is an open access resource. The data underlying this project were accessed using application number 67506.

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Frequency of Consumption of Fast-Food Products and Good Food and the Nutritional State of Junior School Students in the Mys'lenice Powiat in the Years 2016–2017[†]

Jas'mina Zwirska *, Ewa Błaszczyk-Be_benek[†]  and Paweł Jagielski 

Citation: Zwirska, J.;

Błaszczyk-Be_benek, E.; Jagielski, P.

Frequency of Consumption of Fast-Food Products and Good Food and the Nutritional State of Junior School Students in the Mys'lenice Powiat in the Years 2016–2017.

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Abstract: Background: Nutrition is one of the most important elements of the external environment affecting human health. Aim: We aimed to evaluate the frequency of consumption of fast-food products and the nutritional status of adolescents aged 12–16 in 2016–2017 by gender. Material and methods: In 2016–2017, an assessment of the diet and nutritional status of junior high-school students was carried out (consent of the Bioethics Committee of the Jagiellonian University). A total of 700 junior high-school students were examined. After removing incomplete questionnaires, 664 were included in the analysis. The obtained results were statistically processed. Results: Among the 664 examined children, there were 314 boys (47.3%) and 350 girls (52.7%). The average age of the surveyed youth was 13.85 ± 0.78 years. In the sex groups, there were statistically significant differences in the frequency of consumption of fast-food products and snacking depending on BMI. Sweets were eaten by 73.5% of girls and 65.7% of boys with malnutrition and 42.6% of girls and 46.0% of boys who were overweight or obese. Pastry was eaten by 31.4% of boys and 20.4% of girls with malnutrition. Fruit was eaten by 85.2% of overweight and obese girls and 65.7% of normal and malnourished boys. In the study group, overweight and obese boys significantly less frequently (46.0%) ate fruit ($p = 0.0156$) and confectionery ($p = 0.0131$) compared to normal and malnourished boys (65.7%). Overweight and obese girls ate sweets significantly less often (42.6% vs. 54.7%; $p = 0.0064$) and ate fruit significantly more often (85.2%; $p = 0.0156$) compared to girls with normal weight and malnutrition (76.5%). Fast-food products were eaten once a month by 68.5% of girls and 44.4% of overweight and obese boys. There were no significant differences in the consumption of fast-food products in the group of boys ($p = 0.8071$), and girls with malnutrition consumed these products significantly more often ($p = 0.0172$). Discussion: Research by many authors shows that the majority of adolescents have erroneous and unfavorable eating behaviors, consisting of a diet with little variety, rich in products of low nutritional value. Conclusions. Significant differences in the frequency of consumption of fast-food products and snacking depending on BMI in the sex groups were observed.

Keywords: the frequency of consumption; nutritional state; children

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Effect of an Energy-Restricted Mediterranean Diet, Physical Activity and Behavioral Support Lifestyle Intervention on Body Composition in Older Adults with Metabolic Syndrome: Three-Year Results of the PREDIMED-Plus Trial [†]

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Ramón Estruch ^{2,8}, Jordi Salas-Salvadó ^{2,9,10}  and Jadwiga Konieczna ^{1,2}



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Abstract: Background and objectives: Large and long-term randomized controlled trials (RCT) that test the effect of a weight-loss lifestyle intervention on the changes in the directly quantified body composition are scarce. Here, we aimed to evaluate the effect of an intensive nutritional and behavioral weight-loss intervention with an energy-restricted (er) Mediterranean Diet (MedDiet) on the changes in age-related overall and regional body composition objectively measured over three years. Methods: Body composition was measured with dual energy X-ray absorptiometry (DXA) in a subsample of 1521 participants (aged 55–75 years with overweight/obesity and metabolic syndrome) in the PREDIMED-Plus trial assigned (1:1) to multifactorial intervention with erMedDiet, increased physical activity (PA) and behavioral support (intervention) or usual care with advices to follow MedDiet without energy restriction or PA promotion (control group). The primary outcomes were 3-year changes in total fat and lean mass (expressed as % DXA-derived total body mass) and visceral fat (in grams). The potential interactions of study arm with time were tested in crude and multivariable linear-mixed effects models with repeated measurements at baseline and at 1 and 3 years. Results: After a 3-year follow-up, in the completers-only analysis adjusting for baseline characteristics, participants in the intervention vs. control group showed higher reductions in the % of total fat (mean difference of -0.38% , 95% CI -0.64 ; -0.12 , $p < 0.001$) and the grams of visceral fat (-70.4 g, -126 ; -15.2 , $p < 0.001$), as well as an increase in the % of total lean mass (0.34% , 0.09 ; 0.60 , $p < 0.001$). Discussion: The PREDIMED-Plus lifestyle weight-loss-focused intervention approach with erMedDiet and PA may suppress the age-dependent changes in body composition by reducing total and visceral fat and delaying the loss of lean mass in relation to the total body mass in older overweight/obese adults with metabolic syndrome.

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Institutional Review Board Statement: The PREDIMED-Plus study protocol was reviewed and approved by the institutional review boards from all 23 participating centers.

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Data Availability Statement: There are restrictions on data availability for the PREDIMED-Plus trial due to the signed consent agreements around data sharing, which only allow access to external researchers for studies following the project purposes. Requestors wishing to access the PREDIMEDPlus trial data used in this study can make a request to the PREDIMED-Plus trial Steering Committee chair: jordi.salas@urv.cat. The request will then be passed to members of the PREDIMED-Plus Steering Committee for deliberation.

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Digital Health Technologies for Coeliac Disease: A Realist Approach [†]

Rosie Cooper ^{1,*}, Matthew Kurien ², Steve Ariss ² and Geoff Wong ¹



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Coeliac disease (CD) is a chronic autoimmune condition, estimated to affect around 1% of the global population. Without treatment, CD increases the risk of serious complications such as malabsorption, malnutrition, and cancer. Treatment requires life-long adherence to a gluten-free diet (GFD) which aims to reduce the risk of complications and preserve individuals' functional status and quality of life (QoL). As a chronic condition, life-long healthcare is recommended for individuals with CD in the form of structured monitoring and follow-up, often resulting in significant health and economic costs to both the individual and wider society. One solution is providing CD healthcare using digital health technologies. To explore how digital technologies may work

(or not) for individuals with CD, and for those with chronic gastrointestinal conditions, a realist evaluation methodology is being employed between 2022–2025. As part of this project, A realist synthesis is first being undertaken between 2022–2024; due to the scarcity of research on digital health technologies, searches were widened to consider the impact of digital health technologies on any gastrointestinal condition. Searches retrieved over 1000 articles which were assessed for relevance and rigour. Included articles were thematically coded and synthesised. Findings included effectiveness and benefits to individuals in a range of areas including QoL, GFD-adherence and reduction in face-to-face appointments, as well as reports of no effect. The two important advantages of healthcare through digital technologies for this group appeared to be the ability to be assessed in real-time and the option to access interventions within the relevant context. These functions were reported to often provide reassurance for individuals with CD and improve their QoL. The use of such technologies also enabled healthcare professionals to remotely assess their patients' symptoms and GFD-adherence, enabling early detection of complications as well as support for individuals at the time point needed. Further research is now being conducted to determine for whom these technologies work, with a particular focus on understanding healthcare inequalities.

Keywords: coeliac disease; digital healthcare; digital health technologies; realist; follow-up

Author Contributions: Conceptualisation: R.C., M.K., S.A. and G.W. Methodology: R.C., M.K., S.A. and G.W. Writing—original draft: R.C. Writing—review and editing: M.K., G.W. and S.A. Supervision: M.K., S.A. and G.W. Project administration: R.C. Funding acquisition: R.C. All authors have read and agreed to the published version of the manuscript.

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The Environmental Impacts of Omnivorous, Vegetarian, and Vegan Children and Adolescents in Germany: Results of the VeChi Diet and VeChi Youth Studies [†]

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Abstract: Background and objectives: There is a lack of data on the environmental impact of chil-

dren's and adolescents' food consumption as most studies only consider adult dietary intake and, in addition, use hypothetical diets or focus on specific food products. Hence, our aim was to assess two indicators of environmental impact of the total diet among omnivorous (OM), vegetarian (VG), and vegan (VN) children and adolescents from Germany. **Methods:** Greenhouse gas emissions (GHGE) and land use (LU) were calculated using 3-day weighed dietary records from 820 participants (1–18 years old) of the cross-sectional VeChi Diet Study ($n = 430$, 1–3 years of age, conducted 2016–2018), the

VeChi Youth Study ($n = 390$, 6–18 years, 2017–2019), and the life cycle-analyses food-item (SHARPIndicators) database. Group differences of indicators were analysed using analysis of covariance.

Results: On average, food consumption of OM, VG, and VN diets caused GHGE of 2.6, 1.6, and

1.0 kg CO₂eq/kg food and LU of 3.1, 2.0, and 1.6 m²-year/kg food, respectively. The median total daily GHGE and LU amounts differed significantly between diet groups ($p < 0.001$). Standardisation to energy intake per 1000 kcal (GHGE: (OM) 2.2, (VG) 1.3, (VN) 0.9 kg CO₂eq/1000 kcal; LU: (OM) 2.5, (VG) 1.6, (VN) 1.3 m²-year/1000 kcal) confirmed these results. **Discussion and conclusions:** To the best of our knowledge, this is the first evaluation to show that even in children and adolescents, the GHGE and LU caused by an OM diet is considerably higher than the GHGE and LU on a VG or VN diet. In this way, plant-based diets performed better in terms of environmental sustainability.

Keywords: environmental impacts; greenhouse gas emissions; land use; sustainability; child nutrition; vegan diet; vegetarian diet

Author Contributions: U.A., M.K. and S.W. designed the VeChi Diet and VeChi Youth study; U.A. and M.K. supervised the study; M.F., S.W., A.M. and A.L. were involved in the implementation and data collection; L.K. analysed the data and drafted the manuscript under the supervision of W.G. and S.W.; A.S. supervised the laboratory analysis; V.K. presented the manuscript at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The studies were conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the University of Witten/Herdecke (VeChi Youth Study, 139/2017, 21 September 2017) and by the Ethics Committee of the University of Bonn (VeChi Diet Study, 046/17, 2 March 2017).

Informed Consent Statement: Informed consent was obtained from all subjects (or their parents) involved in the studies.

Data Availability Statement: The data described in the manuscript might be made available on request.

Conflicts of Interest: All authors declare no conflicts of interest.

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Nutrient Intake from Fortified Foods and Supplements in Vegan, Vegetarian, and Omnivorous Participants Aged 6 to 18 Years in Germany: Results from the VeChi Youth Study [†]

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Citation: Dietrich, J.; Keller, V.; Fischer, M.; Weder, S.; Alexy, U.; Michalsen, A.; Längler, A.; Sputtek, A.; Keller, M. Nutrient Intake from Fortified Foods and Supplements in Vegan, Vegetarian, and Omnivorous Participants Aged 6 to 18 Years in Germany: Results from the VeChi Youth Study. *Proceedings* **2023**, *91*, 429. <https://doi.org/10.3390/proceedings2023091429>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: **Introduction:** The German market for dietary supplements and fortified foods is of considerable size, and many target-group-specific products, e.g., for vegans and vegetarians, are available. Growing sales volumes in recent years reflect the large demand for these products. However, the broad variety and easy availability may lead to unfavorable use of these products. **Methods:** The VeChi Youth Study (2017–2019) was a cross-sectional study among vegan (VN), vegetarian (VG), and omnivorous (OM) participants aged 6 to 18 years ($n = 401$). Dietary data were collected from 3-day weighed dietary records ($n = 390$). The present analysis investigates nutrient intake from dietary supplements and unfortified/fortified foods. **Results:** VN had the highest dietary supplement use and the highest intake of fortified foods (both significantly different from OM; $p < 0.0001$ and $p = 0.0342$, respectively). Among VN and VG, vitamins B12 and D were the most frequently supplemented nutrients, while among OM, this was vitamin C. The mean nutrient intake from dietary supplements (excluding vitamins B12 and D) and fortified foods contributed up to 49% and 11% of the German reference values, respectively. Except for iron, VN had the highest mean intake of all nutrients from dietary supplements. Including unfortified and fortified foods as well as supplements, the mean intake in all three diet groups reached the reference values for vitamin B12, vitamin C, iron, and zinc but not for calcium and iodine. **Discussion:** Dietary supplements, and to a smaller extent fortified foods, increased the nutrient intake of the participants of the VeChi Youth Study. In order to achieve recommended intakes, the intake of dietary supplements and fortified foods was either unnecessary (e.g., vitamin C), not sufficiently effective (e.g., calcium and iodine), or effective (e.g., vitamin B12). **Conclusions:** Specific intake of dietary supplements is useful to improve the intake of critical nutrients in VN and VG diets, especially for vitamins B12 and D. In Germany, fortified foods appear to contribute only to a small extent to the intake of critical nutrients in VN and VG children and adolescents.

Keywords: child nutrition; fortified foods; dietary supplements; nutrient intake; critical nutrients; vegan diets; vegetarian diets

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Author Contributions: U.A., M.K. and S.W. designed the VeChi Youth study; U.A. and M.K. supervised the study; M.F., S.W., A.M. and A.L. were responsible for the implementation and data collection; J.D. analysed the data and drafted the manuscript; A.S. supervised the laboratory analysis; V.K. presented the manuscript at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of the University of Witten Herdecke (139/2017, 21 September 2017).

Informed Consent Statement: Informed consent was obtained from all subjects (or their parents) involved in the study.

Data Availability Statement: The data described in the manuscript might be made available on request.

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Post Hoc Subgroup Analysis and Identification—Learning More from Existing Data [†]

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Abstract: Personalized nutrition aims to exploit heterogeneity. One reason for heterogeneity may be the presence of one or more subgroups that respond better to a dietary intervention than the observed average in the entire population considered. However, designing studies solely with the intention to carry out subgroup analyses is challenging as the subgroups may be unknown. In addition, anticipated subgroup effects are rarely known in advance. This study investigates the usefulness of a methodology where principled post hoc investigations of subgroup effects are used. By means of both supervised and unsupervised learning approaches, relevant subgroups were identified using baseline covariate information. The unsupervised approach involved a principled search strategy for determining optimal cut-offs such as regression trees. Once subgroups had been identified, statistical models including treatment-subgroup interactions were fitted to estimate the subgroups effects. Data from a published nutrition trial on weight loss in children were re-evaluated to identify the subgroups that benefitted more than the average from the dietary intervention. Very preliminary results indicated that a number of subgroups could be identified using baseline covariates. Subgroup analysis seems to be underutilized in nutrition, forfeiting valuable information that could potentially inform future personalized nutrition strategies. This is particularly relevant as it is a common finding that nutrition trials only detect small average effects of dietary interventions.

Keywords: subgroup analysis; interaction; regression trees; baseline covariates; personalized nutrition

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Author Contributions: Revision of the manuscript, E.M. Comments to the manuscript, P.G.F. Initiation, comments and revision of the manuscript, C.R. All authors have read and agreed to the published version of the manuscript.

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Comparative Evaluation of a Dietary Fiber Mixture in an Intestinal Screening Platform and a Crossover Intervention Study [†]

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Abstract: In personalized nutrition, specific recommendations are often based on extensive phenotyping. In the world of microbiome research, classification is often based on the bacteriological composition of gut microbiota and enterotypes. We investigated if there is a possibility of translating outcomes from an intestinal screening platform to an intervention study that makes use of phenotyping. A 12-week double-blind, randomized, placebo-controlled, crossover intervention study (8-week wash-out period) with a dietary fiber mixture of acacia gum and carrot powder (ratio 3.33:1) was performed in healthy volunteers (N = 54, 45–70 years, BMI 27.3 ± 1.4) to modulate their microbiome. Fecal samples were collected every 4 weeks during the 32-week study period. Before and after the intervention a standardized mixed meal challenge was performed and plasma samples were taken (0, 30, 60, 120, and 240 min). Postprandial responses were used for subgroup cluster analysis to identify the metabolic phenotype. The individual participants' samples were cultured anaerobically for 24 h with the mixture and the individual fibers. Compositional 16s rRNA data of exposed in vitro (24 h) and in vivo samples (4, 8, and 12 weeks) was compared and linked to the metabolic cluster analysis. The comparison between the clinical intervention's effect on microbiota composition after 12 weeks and a single 24 h exposure in vitro showed a statistically significant association in microbiome effects between in vivo and in vitro exposures ($p < 0.05$) for the fiber intervention. Analysis of the metabolic postprandial responses revealed a division between improvement and deterioration in response to the fiber intervention indicating two distinct clusters (metabolic phenotypes). Cluster 1 contained the lowest triglycerides-, total cholesterol-, and non-esterified fatty acids responses, while cluster 2 contained the highest triglycerides- and total cholesterol responses. Interestingly, the beta diversity of the microbiota was linked to these two clusters, resembling two different responses to the fiber intervention. Our study in healthy individuals demonstrates that a short-term in vitro exposure of individual microbiome samples to the fiber mixture is predictive of a long-term in vivo effect and relates to a distinct phenotypic cluster. This paves the way for using the in vitro platform as a pre-screen for intervention studies.

Keywords: microbiome; postprandial; health; phenotyping; mixed-meal challenge test

Author Contributions: Conceptualization, F.P.M.H. and F.H.J.S.; methodology, T.J.v.d.B. and B.E.M.; formal analysis, T.J.v.d.B. and B.E.M.; writing—original draft preparation, F.P.M.H.; writing—review and editing, F.H.J.S., T.J.v.d.B., H.E., I.W., B.E.M. and M.M.; supervision, M.M.; project administration, H.E. All authors have read and agreed to the published version of the manuscript.

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The Impact of Nutritional Status on Gastrointestinal Symptoms, Hyperactivity Disorders, and Sleep Problems in Children with Autism Spectrum Disorder [†]

Fatma Özsel Özcan Araç * and Irem Özcan



Citation: Araç, F.Ö.Ö.; Özcan, I. The Impact of Nutritional Status on Gastrointestinal Symptoms, Hyperactivity Disorders, and Sleep Problems in Children with Autism Spectrum Disorder. *Proceedings* **2023**, *91*, 405. <https://doi.org/10.3390/proceedings2023091405>

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behavior and weakness in social interaction. The nutritional problems experienced by children with autism aggravate the symptoms of autism, but also cause aggravation of the gastrointestinal system, an increase in hyperactivity disorders and sleep problems. This study was conducted to measure the effects of the nutritional status of children with autism on GIS symptoms, hyperactivity disorders and sleep problems. This study was conducted to measure the effects of the nutritional status of children with autism on GIS symptoms, hyperactivity disorders and sleep problems. The study was carried out with the families of children with autism at Kartal Umut Is,ig'i Special Education and Rehabilitation Center. Within the scope of the study, a questionnaire consisting of four parts was given to the parents of 62 children with autism. The questionnaire included a voluntary consent form, personal information form, Conners Parent Rating Scale (CADS-48) and food frequency questionnaire. The parents completed these questionnaires in a face-to-face environment. The data obtained from the questionnaires were analyzed and presented with the SPSS 22 program. As a result of the study, it was found that different food groups can affect GI problems, hyperactivity disorders and sleep problems. It was found that the children who consumed dry broad beans did not have GIS complaints, and the children who consumed fast food experienced the problem of hyperactivity more regularly ($p < 0.05$). It was concluded that children who did not have GIS problems did not have sleep problems ($p < 0.05$). It was confirmed that simple carbohydrate consumption causes hyperactivity in children, but no significant results were found regarding GI problems and sleep disorders in the literature, and there are studies that overlap or contradict our study. More work is needed on this subject.

Keywords: autism spectrum disorder; Gastrointestinal Symptoms (GIS); hyperactivity disorders

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Abstract: Autism spectrum disorder is a neurodevelopmental disorder that presents with repetitive

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Leveraging Machine Learning and Genetic Risk Scores for the Prediction of Metabolic Syndrome in Children with Obesity [†]

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Gloria Bueno ^{2,4,6} , Rosaura Leis ^{7,8} and Jesús Alcalá-Fernández ⁹



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Machine Learning and Genetic Risk

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Obesity is a growing global epidemic, associated with increased cardiometabolic disorders. Metabolic syndrome (MS) is defined by altered insulin, blood pressure, glucose, and lipid levels. Pubertal children with obesity are highly susceptible to developing MS, necessitating its early identification. This study aims to compute phenotype-specific genetic risk scores for MS-related biochemical markers and evaluate their clinical utility using machine learning-based models. Methods: Longitudinal data from the PUBMEP Spanish cohort were analyzed, including 138 children (71 girls and 67 boys) at two time points, spanning from prepuberty to puberty. Clinical, endogenous, environmental, and omics variables were measured. Genetic risk scores were generated using GWAS data and PRSice-2 software. These scores, alongside non-genetic prepubertal data (e.g., biochemical, anthropometric, and physical activity data), were integrated into predictive models using machine learning techniques to forecast the MS status during puberty. Linear models explored interactions between environmental factors, genetic risk scores, and disease risk. Results: Strong associations were observed between each genetic risk score and its corresponding phenotypic biomarker. Notably, certain scores related to obesity and high-density lipoprotein levels exhibited significant interactions with environmental factors, such as sedentary lifestyle, modulating disease effects. The predictive machine learning models incorporating prepubertal genetics, high-density lipoprotein, and sedentary lifestyle achieved reasonable performance in predicting pubertal obesity (AUC, accuracy, and sensitivity of 0.89). These models strike a favorable balance between risk scores derived from genetic factors and clinical variables. However, when individual risk scores were considered in isolation, limited predictive results were observed for MS and associated altered components. Discussion: This study demonstrates the importance of the early identification of at-risk children for MS. The integration of genetic risk scores, clinical variables, and machine learning techniques offers promising avenues for predicting pubertal MS. While individual risk scores have limitations in isolation, polygenic risk scores serve as valuable tools for investigating gene–environment interactions. Following our results, polygenic risk scores lacked sufficient predictive

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ability in most clinical traits, limiting their clinical application. Nevertheless, they remain valuable analytical tools for exploring the association with the environment, by consolidating the effects of multiple single nucleotide polymorphisms into a single variable.

Keywords: machine learning; genetics; gene-environment interaction; genetic markers; childhood obesity; polygenic risk scores



Author Contributions: Conceptualization, C.M.A., A.A.-R. and J.A.-F.; methodology, M.B.-A., A.A.-R. and J.A.-F.; software, M.B.-A., Á.T.-M. and A.A.-R.; validation, M.B.-A., A.A.-R. and J.A.-F.; formal analysis, M.B.-A., A.A.-R. and J.A.-F.; investigation, C.M.A., A.A.-R. and J.A.-F.; resources, C.M.A., G.B., R.L. and J.A.-F.; data curation, M.B.-A., A.A.-R. and Á.T.-M.; writing—original draft preparation, C.M.A., M.B.-A., A.A.-R. and J.A.-F.; writing—review and editing, C.M.A., M.B.-A., A.A.-R., Á.T.-M., G.B., R.L. and J.A.-F.; supervision, C.M.A., A.A.-R. and J.A.-F.; project administration, C.M.A., G.B., R.L. and J.A.-F.; funding acquisition, C.M.A., G.B., R.L. and J.A.-F. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was authorized by the Ethics Committee of the Reina Sofia Hospital, in accordance with the recommendations of the European Union's Good Clinical Practice (Document 111/3976/88 July 1990) and following the Revised Declaration of Helsinki. It was also approved by current Spanish legislation regulating clinical studies with human subjects (RD 223/04 on clinical trials).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Due to stringent privacy and ethical considerations, the raw data supporting the conclusions of this article cannot be made available by the authors, but further information about the data and how it was collected can be provided upon request with the understanding that the privacy of all participants will be preserved.

Conflicts of Interest: The authors declare no conflict of interest.

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The Effectiveness of Specific Pieces of Advice in Personalized Nutrition—An Example from the German Food4Me Sub-Cohort [†]

Kurt Gedrich ^{1,2,*} , Silvia Kolossa ¹ and Kai Hartwig ¹



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Abstract: Personalized Nutrition (PN) has shown that dietary changes can be facilitated by individualized approaches, even if the communication between experts and recipients is automatized and based on



algorithms, rather than personal contacts. However, little is known about to what extent recipients' behavior is affected by specific pieces of advice. In total, 220 healthy adults were recruited as the German sub-cohort of the Food4Me Proof-of-Principle study. They were randomly assigned to either the control group (n0 = 51) or to one out of six intervention groups receiving PN advice at various depths (3 levels) and frequencies (2 intensity groups). Depending on the depth of personalization, the dietary advice was based on information obtained from food frequency questionnaires (FFQs), anthropometry, biomarkers, or the analyses of five single nucleotide polymorphisms. Depending on the frequency of intervention, data were collected either three or five times within six months, and respective PN advice was given based on decision trees

that identified three target nutrients and selected appropriate messages out of a set of approx. 550 predefined text modules. Messages were considered effective if subsequent FFQs showed dietary changes in line with the given PN advice. Results: The subjects received a total of 1228 target nutrient recommendations. Most frequently, the desired dietary changes were provoked by messages related to increased intakes of carbohydrates, as well as poly- and monounsaturated fatty acids (approx. 80%). But the advice to increase the intake of fiber or carotenoids was only put into practice in less than 60% of the cases. Multifactorial ANOVA revealed that significant changes ($p < 0.05$) were triggered by most of the target nutrient recommendations, e.g., for total fat, saturated as well as mono- or polyunsaturated fatty acids, carbohydrates, or dietary fiber. However, messages addressing the intake of omega-3 fatty acids, calcium or folate did not significantly contribute to respective dietary changes. Predefined pieces of PN advice are not equally effective. Further research is required to better understand how to optimize PN messages with respect to comprehensibility, feasibility, acceptability, and willingness to comply.

Keywords: personalized nutrition; dietary behavior change; Food4Me; effectiveness; communication

Author Contributions: Conceptualization, K.G. and S.K.; methodology, K.G., S.K. and K.H.; data collection, S.K. and K.H.; manuscript, K.G., S.K. and K.H. All authors have read and agreed to the published version of the manuscript.

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Harnessing Artificial Intelligence for the Provision of Personalised Nutrition Advice to Population Groups across the UK [†]

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Abstract: Personalised nutrition could promote greater adherence to a healthy lifestyle, and thereby potentially improve health outcomes. The principal aim of the PROTEIN project was to develop a mobile application that delivers tailored nutrition advice to adults. In this pilot study, 80 participants were recruited from the general public and sorted into three groups: (i) adults with a poor-quality diet (PQD, n 29), (ii) adults with iron deficiency anaemia (IDA, n 11; Hb < 120 mg/L) and (iii) adults who were overweight (OW, n 40; BMI 25–30 kg/m²). The participants provided baseline anthropometric and general health data, which were inputted into the PROTEIN dashboard, along with their dietary preferences and individual goals, triggering the generation of an individualised 7-day nutrition and activity plan (NAP), which the participants were encouraged to follow. Their interactions with the app were determined through the number of occasions the user would either ‘confirm’ that they had consumed or ‘skipped’ a recommended meal. They were also expected to rate the meals and input their own instead of, or as well as, those recommended. Following 4 weeks of use, the participants were asked to complete online questionnaires on the usability of the app and report their current weight. The data are presented as mean (±SD); the significance was set at $p < 0.05$. The mean age and BMI were 44.7 ± 16.1 years and 27.7 ± 5.5 kg/m², respectively, for the whole sample. Over 90% of the users did not confirm that they had consumed or skipped a meal, thereby suggesting a lack of user acceptability of the meal plans provided. However, the OW group users who completed the intervention (n 32) reported an average of -1.1 ± 1.4 kg weight loss. The responses to questionnaires from all users suggested that the app increased their ‘motivation to’ and ‘ability to eat a healthy diet’ (n 35 and 41, respectively). Overall, the PROTEIN app could motivate users to improve their lifestyle, in line with previous pilots. Furthermore, the system could accurately define appropriate meal plans and aid its users achieve their personal ‘goals’. Future versions of the mobile app should focus on developing a more user-friendly system to increase interaction.

Keywords: personalised nutrition; m-health; public health

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Relationships between Meat and Fish Consumption, N-Acetyltransferase 2 Genotypes, and Colorectal Cancer Risk: A Case–Control Study in the Basque Country [†]

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Background and objective: High consumption of haem iron-rich foods has been associated with colorectal cancer (CRC) risk. However, genetic susceptibility's role remains unclear. Therefore, we studied possible interactions between variants in the NAcetyltransferase 2 (*NAT2*) gene, involved in carcinogenic metabolism, and meat and fish consumption with CRC risk. **Methods:** This observational study includes 229 patients diagnosed with CRC and 229 age- and sex-matched controls from a population-based bowel cancer screening program. Intake of fish and red, white, processed, and grilled meat, as well as three slow *NAT2* acetylator variants (rs1801280, rs1799930, and rs1799931), was analyzed. Logistic conditional regression was used to calculate odds ratios (ORs) and 95% confidence intervals (95% CI) for CRC risk. **Results:** The CT genotype of rs1801280 and AA genotype of rs1799930 may increase CRC risk (adjusted model: OR = 2.91, 95% CI 1.50–5.64, $p = 0.002$; OR = 0.24, 95% CI 0.08–0.74, $p = 0.013$). Moreover, the consumption of processed meat and of red meat were both associated with the risk of CRC (adjusted model, processed meat tertile 2 vs. 1, OR = 3.20, 95% CI 1.37–7.49, $p = 0.007$; red and processed meat, tertile 3 vs. 1, OR = 2.09, 95% CI 1.04–4.21, $p = 0.039$). A significant interaction was observed between white meat intake and the CC + CT genotype of rs1801280 (tertile 3 vs. 1, OR = 4.71, 95% CI 1.56–14.24, p interaction = 0.001). **Discussion:** Confirming other authors' works [1,2], our data suggest that the “slow” variants *NAT2* 341T>C and 590G>A and the intake of red and processed meat were related to CRC risk. Additionally, the variant *NAT2* 341T>C may modify the association of white meat intake with CRC risk.

Author Contributions: Conceptualization, M.M.d.P. and M.A.-I.; investigation (data collection), I.A.-L. and M.A.-I.; formal analysis, I.A.-L., O.E.-R. and M.A.-I.; writing—original draft, review &

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Liking Milk Chocolate, Dairy Food and Eating Behaviour (Impulsivity) Are Linked to a Specific Genomic Region [†]

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Abstract: Eating behaviour (EB) is a complex system affected by different factors, including food liking and psychology. Researchers have highlighted the importance of genetics in EB, but little is known. Therefore, this study aimed to investigate the genetic factors involved in EB in Italian cohorts, Friuli-Venezia Giulia (FVG) and Val Borbera (VB). Genome-Wide Association Studies (GWAS) on food liking were performed in FVG ($n = 575$). The relationships between the genetic findings and other variables of interest (i.e., psychological outcomes) were evaluated using linear regression models. A replication study was carried out in an independent cohort (VB, $n = 701$). GWAS revealed a significant association between the liking of milk chocolate and a region on chromosome 5. The most associated single nucleotide polymorphism (SNP) was rs73280705 ($p = 1.02 \times 10^{-9}$), an eQTL for the *LARP1* gene in the nucleus accumbens (NAc). Subjects carrying the minor allele of the SNP show a reduced liking for milk chocolate, as well as a minor overall liking for a milk-based food group. The latter finding was replicated in VB ($p = 0.026$). Regarding the psychological data, these subjects also present a reduced impulsivity ($p = 0.031$). On the other hand, carriers of the counterpart allele show an increased liking for milk-based food and a high impulsivity ($p = 0.023$). These data are not influenced by the lactose deficiency allele. The results suggest that this genetic region could play a role in both impulsivity and food liking. Indeed, individuals carrying the *LARP1* gene variant show a decrease in liking for milk chocolate and milk-based food, as well as in impulsivity, while the others are more impulsive, like more milk-based foods and, in general,



sweet and fatty foods. *LARP1* is expressed in the NAc, which is a central driver of reward response controlling the pleasantness and gratification given by food (mostly triggered by highly palatable foods). Moreover, the NAc also plays a role in integrating limbic system stimulation into the motor system, which can lead to addictive and impulsive behaviours. Additional studies are needed to increase our knowledge on this extremely

interesting gene association and, overall, on the *LARP1* gene's relationship with milk and *mTORC1*, food liking, and EB.

Keywords: eating behaviour; food liking; impulsivity; genetics; nucleus accumbens

Author Contributions: Conceptualization, P.G. and M.P.C.; methodology, M.P.C.; software, M.P.C.; validation, S.C. and M.P.C.; formal analysis, S.C., A.P. and M.P.C.; investigation, S.C., A.P. and M.P.C.; resources, P.G.; data curation, S.C., A.P. and M.P.C.; writing—original draft preparation, S.C. and M.P.C.; writing—review and editing, S.C., A.P., P.G. and M.P.C.; visualization, S.C.; supervision, M.P.C. and P.G.; project administration, P.G. and M.P.C.; funding acquisition, P.G. All authors have read and agreed to the published version of the manuscript.

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The Genetics of Sweet Taste: Perception, Feeding Behaviours, and Health [†]

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Abstract: Background: Sweet taste is partly modified by genetics. The rs35874116 single-nucleotide polymorphism (SNP) in taste receptor type 1 member 2 (TAS1R2) reduces the availability of a G protein-coupled receptor (GPCR), which binds to ‘sweet’ molecules. This might alter sweet taste perception, diet choices, and health outcomes. However, these findings, and other genes and pathways involved in sweet taste are yet to be identified. Therefore, a candidate gene study on TAS1R2 and a genome-wide association study (GWAS) exploring these outcomes were performed. Methods: TAS1R2 rs35874116, sweet perception, liking, diet, and health were investigated in two age and sex-matched European cohorts (UK, $n = 50$ /Italy, $n = 235$). Linear models were used to explore associations. The GWAS was performed with 2555 Italian participants. Associations with sweet food liking, food adventurousness (FA), reward dependence (RD), and health were explored. Results: The wildtype of TAS1R2 was associated with increased sweet taste and food liking ($p = 0.049$, $\beta = 0.62$, $p = 0.038$, $\beta = 0.45$), increased fibre consumption ($p = 0.006$, $\beta = 7.95$), and decreased HDL cholesterol

($p = 0.025$, $\beta = -3.56$). The GWAS identified rs58931966 in the regulator of G-protein signalling 9 (RGS9) gene. The minor allele was associated with decreased sweet food liking ($p = 7.05 \times 10^{-9}$, $\beta = 0.3$), a higher BMI ($p = 0.007$, $\beta = 0.391$), serum glucose ($p = 0.013$, $\beta = 1.211$), lower FA ($p = 0.049$, $\beta = -0.065$), and RD ($p = 0.011$, $\beta = -3.840$). Discussion: The TAS1R2 results show that taste receptor variations are associated with preference, diet, and health-related outcomes. TAS1R2 not reaching significance in the GWAS shows that sweet food liking is modified by pathways besides taste reception. RGS9 is expressed in the striatum, which is involved in the mesolimbic reward pathway, which is activated by sweet taste. RGS9 rs58931966 may moderate dopaminergic signalling in response to sweet foods via the negative regulation of G-protein signalling. This might explain why the minor allele was associated with reduced RD. The lower FA might decrease preference for bitter-tasting vegetables, which could explain the higher BMI and serum glucose. The FA and RD results provide evidence that food choice depends on psychological/biological interplay. These results show that sweet taste is modified by multiple pathways and genes, and variations can modify taste, diet, and health outcomes.

Keywords: genetics; diet; health; sweet-taste; sweet-liking

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M.G. and M.P.C.; writing—review and editing, H.S., F.P., C.A.-M.G. and M.P.C.; supervision, P.G., C.A.-M.G. and M.P.C.; project administration, P.G., Y.M., C.A.-M.G. and M.P.C.; funding acquisition, P.G., Y.M. and L.P. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: A subset of the data is already available in the European Genomephenome Archive (EGA) at the following links. FVG cohort: BAM files <https://www.ebi.ac.uk/ega/studies/EGAS00001000252> (accessed on 3 November 2023); sample list, vcf files <https://www.ebi.ac.uk/ega/studies/EGAS00001001597> (accessed on 3 November 2023); <https://www.ebi.ac.uk/ega/datasets/EGAD00001002729> (accessed on 3 November 2023); VBI cohort: BAM files <https://www.ebi.ac.uk/ega/studies/EGAS00001000398> (accessed on 3 November 2023); <https://www.ebi.ac.uk/ega/studies/EGAS00001000458> (accessed on 3 November 2023). Other data presented in this study are available on request from the corresponding author.

Conflicts of Interest: L.P. is the founder of Optimyse Nutrition LTD, a personalised nutrition company offering genetic testing to clients. Y.M. is an advisor in nutrition genetics for the wellbeing company MyHealthChecked.

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Investigating the Role of Genetics in Fatty Acids Oral Perception and Related Traits in Two European Cohorts [†]

Francesco Piluso ^{1,2,*} , Harry Stevens ^{1,2} , Catherine Anna-Marie Graham ^{2,3} , Alexandra King ⁴, Leta Pilic ⁴, Paolo Gasparini ^{1,2,5} and Maria Pina Concas ⁵ 



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Unsaturated fatty acids (FAs) can influence various aspects of human biology (e.g., the immune system), and an excess of saturated fatty acids is associated with non-communicable diseases. The orosensory perception of FAs has been demonstrated and debated as a possible sixth taste. The Cluster of Differentiation 36 (*CD36*) gene codes for a membrane protein apically located in taste bud cells, which is considered a possible fat taste mediator. The single nucleotide polymorphism (SNP) rs1761667 (G>A) is associated with a reduced protein expression, possibly leading to fat taste hyposensitivity, but the results are controversial. Here, we investigate, in two European cohorts, rs1761667's role on taste perception, food liking as an intake determinant, and diet-related traits. We analysed two cohorts from the UK (n = 49; 63% female) and Italy (Friuli Venezia Giulia (FVG); n = 235; 54% female). Data collected were taste perception and liking via actual foodstuffs in the UK; food liking, as evaluated by a questionnaire, in FVG; the rs1761667 genotype; and BMI as an indicator of non-communicable diseases. The effect of the SNP on the considered phenotypes was evaluated using linear regression models. In the UK, A-allele carriers showed higher perceived intensity ($\beta = 0.99$; $p = 0.02$) and reduced liking, although not significant ($\beta = -0.30$), from fat food sample; in the FVG cohort, we replicated the negative association between A-allele carriers and fat liking, specifically for "gorgonzola" cheese (β -value = -0.82 ; $p = 0.03$). These results align with the negative relationship seen between fat intensity and liking ($\text{cor} = -0.2$). Regarding other tastes, we found that A-allele carriers (UK) showed higher umami food perceived intensity (β -value = 0.89 ; $p = 0.02$) and reduced liking (FVG) for an umami food ("soy sauce") (β value = -0.97 ; $p = 0.02$). Similarly, in the UK, the relationship between umami intensity and liking was negative ($\text{cor} = -0.32$).

Considering effects on health status, we found that A-allele carriers (UK) showed an increased BMI (β -value = 2.02 ; $p = 0.02$). Our results show that the A-allele is associated with an increased perceived intensity and a decreased liking for fatty foods. In addition, a novel association was found between umami perception/liking and rs1761667. Further research is required to elucidate these observations and the possible effects on taste perception and dietary intake. **Keywords:** genetics; personalised nutrition; fatty acids; CD36



Author Contributions: Conceptualization, P.G., C.A.-M.G., M.P.C., A.K. and L.P.; methodology, M.P.C., A.K. and L.P.; software, M.P.C., F.P. and H.S.; validation, F.P., C.A.-M.G. and M.P.C.; formal analysis, F.P., C.A.-M.G. and M.P.C.; investigation, F.P., H.S., C.A.-M.G., M.P.C., A.K. and L.P.; resources, P.G., A.K. and L.P.; data curation, M.P.C., A.K., P.G. and L.P.; writing—original draft preparation, F.P., C.A.-M.G. and M.P.C.; writing—review and editing, F.P., H.S., C.A.-M.G. and M.P.C.; supervision, C.A.-M.G., M.P.C. and P.G.; project administration, P.G., L.P., C.A.-M.G. and M.P.C.; funding acquisition, P.G. and L.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.**Data Availability Statement:** A subset of the data is already available in the European Genomephenome Archive (EGA) at the following links. FVG cohort: BAM files <https://www.ebi.ac.uk/ega/studies/EGAS00001000252> (accessed on 13 November 2023); sample list.



Abstract

vcf files <https://www.ebi.ac.uk/ega/studies/EGAS00001001597> (accessed on 13 November 2023); The raw data supporting the conclusions of this article from the United Kingdom will be made available by the authors on request.

Conflicts of Interest: L.P. is the founder of Optimyse Nutrition LTD, a personalised nutrition company offering genetic testing to clients.

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Abstract

Exploring the Inter-Individual Variability in Response to Food in Seniors Living at Home: The MetabotypAGE Project [†]

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Citation: Manach, C.; Gladine, C.; Morand, C.; Mosoni, L.; Pujos-Guillot, E.; Rémond, D.; Polakof, S. Exploring the Inter-Individual Variability in Response to Food in Seniors Living at Home: The MetabotypAGE Project. *Proceedings*

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Abstract: There is a high inter-individual variability in response to food, determined by multiple interacting factors, such as age, sex, genotype, gut microbiota, eating behaviours, physical activity or socio-demographic factors. Previous studies demonstrated the possibility to predict the postprandial glycemic response to food in healthy adults based on deep phenotyping. We hypothesize that inter-individual variability may be amplified at later ages, as a result of different life trajectories and long-life exposures. The MetabotypAGE project proposes exploring the inter-individual variability in response to food in the elderly (ClinicalTrials.gov Identifier NCT06163794). The first interdisciplinary task aimed to establish the best tools and methods to recruit a large highly diverse group of subjects including those living in rural areas, and to carry out deep phenotyping adapted to the older population living at home. The second objective of MetabotypAGE is an exploratory study on 150 healthy people aged 60 to 75, who will wear a CGM for 2 weeks, during which they will eat four standardized test meals. Their post-prandial glycemia will be followed after the test meals. Furthermore, their metabolic flexibility will be assessed with a nutritional challenge test (type PhenFlex) at the clinical center. Volunteers will be extensively phenotyped with a battery of functional tests (physical



apptitude, gustatory, olfactory and masticatory function, cognition, vascular function. . .), analyses on plasma, PBMC, urine, feces and saliva (biochemical, transcriptomics, metagenomics, and metabolomics) and >30 questionnaires to cover many dimensions including their metabolism, physical capacity, socio-economical status, cognitive function, digestive function, and dietary habits. The volunteers will be classified in various metabolotypes using clustering methods, based on

the glycemic responses to test meals. Then, the multidimensional data collected will be used (i) to characterize the metabolotypes (descriptive statistics) and (ii) to explore links between postprandial response to the test meals and the subjects' descriptive data, using correlation networks based on a Gaussian Graphical Model method. The MetabotypAGE consortium combines partners with complementary skills in nutrition and health of the elderly, several clinical research structures, and local players in social action for senior citizens. Our ultimate goal is to lay solid bases for the development of tailor-made recommendations for seniors.

Keywords: deep-phenotyping; seniors; post-prandial glycemia; precision nutrition

Author Contributions: C.M. (Claudine Manach) and S.P.: funding acquisition and project administration. C.M. (Claudine Manach), C.G., C.M. (Christine Morand), L.M., E.P.-G., D.R. and S.P. contributed to conceptualization, methodology, resources. All authors have read and agreed to the published version of the manuscript.

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Food Allergen-Specific Substitutive Diet as a Proposed Tool for Adverse Reactions to Foodstuffs Management: The ALASKA Study [†]

Lisset Pantoja-Arévalo ^{1,*} , Eva Gesteiro ¹ , Jaime López-Seoane ¹ , Asmaa Nehari ¹, Torsten Matthias ², Rafael Urrialde ³ and Marcela González-Gross ^{1,4}



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Abstract: The prevalence of adverse reactions to foodstuffs (ARFS), such as food allergy (FA) and food intolerance (FI), has been increasing worldwide during the past decades. Currently, strict food allergen avoidance is the principal recommended treatment of ARFS. However, individuals with ARFS following elimination diets have shown crucial micronutrient deficiencies. There is an emerging necessity for an effective ARFS strategy which may help mitigate the nutritional deficiency problem. To develop a strategy for the management of ARFS including a food allergen-specific substitutive diet

(FASSD) together with the evaluation of the clinical picture, food consumption, food-allergen profile and quality of life (QoL) in adults with ARFS. The interest of this study is focused on current growing public health problems: FA and FI. The following measurements will be considered: (1) informed consent and inclusion/exclusion criteria forms; (2) symptomatology, food consumption and dietary intake: PSIMP-ARFSQ-10 and FBFC-ARFSQ-18 validated ARFS-specific questionnaires and a 24 h dietary recall interview; (3) immunology: food-allergen profile (IgE and IgG₄ antibodies against 82 common Mediterranean food and beverages) using HELIA[®] Helmed line immunoassay analyzer (Aesku.Diagnostics, Wendelsheim, Germany); (4) enzymatic activity: lactose and fructose breath test using Cerascreen[®] hydrogen and methane detector kit (Cerascreen GmbH, Schwerin, Germany);

(5) QoL aspects: SF-12 and FAQLQ-AF validated questionnaires; (6) six-month FASSD intervention; (7) repetition of measurements from 1 to 6; (8) adjustment of the FASSD. The six-month FASSD was designed for adults aged 18 to 70 years according to individual immunological and enzymatic results. Substitutive foodstuffs were chosen using BEDCA, USDA and NCCDB food composition databases reference tables when they represented the same nutritional value as the foodstuff with positive IgE and IgG₄ reaction (≥ 3.5 kU_A/L). Particular attention was paid to vitamin A, D, E, C, folate, B1, B2, B3, B6, B12, calcium, iron, potassium, magnesium, sodium, phosphorus, iodine, selenium and zinc when choosing the substitutive foodstuffs. The FASSD was developed as a proposed tool to improve health and QoL of adults with symptoms associated with ARFS.

Keywords: allergens; diet; food hypersensitivity; nutrition therapy

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The ALASKA study is ongoing now. The enrollment of participants has been started since April 2022. It is ongoing now and datasets have not been closed.

Conflicts of Interest: T.M. is part of the Aesku.Diagnostics GmbH staff. T.M. did not participate in the design of the protocol or in the analysis and interpretation of the data outcomes. The rest of the authors have nothing to report.

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AI4Food Project: Application of Personalised Nutrition Integrating Artificial Intelligence in Nutritional Interventions Focused on Weight Loss [†]

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Abstract: Obesity is a prevalent and preventable condition that has increased alarmingly in recent decades and is associated with low-grade chronic inflammation and a range of non-communicable diseases. Although the aetiology of obesity has been simplified as an energy imbalance, multiple factors contribute to its development, making its treatment complex. Current methods for diagnosing obesity and overweight have significant limitations therefore, a more personalised approach to nutritional guidance is needed to account for differences in response to dietary affected by environmental and genetic factors. In addition, nutritional therapy and research continue to face issues such as measurement errors, memory biases, and others. The objective of this work is to present the AI4Food project. Massive data capture has been carried out using traditional and digital methods throughout a nutritional intervention for healthy weight loss in order to compare both data collection methodologies and integrate all the information of the variables obtained with artificial intelligence. A total of 93 (28 males, 65 females, mean age of 49.60 (SD ± 12.78) years) participants completed one-month prospective and crossover nutritional intervention with a traditional and digital group. Anthropometric measurements, vital signs, clinical history, and lifestyle habits were registered in all visits. Moreover, in the traditional intervention the questionnaires: 3-day food record, physical activity (IPAQ), sleep pattern (COS), psychological and emotional state (DASS-21), and health status and quality of life (SF-36) were used. In the digital intervention, the sensors Freestyle Libre 2 Glucometer and smartwatch Fitbit Sense were used to monitor glucose levels and lifestyle (heart rate, heart rate variability, sleep patterns, electrodermal activity, etc.) and diet was monitored by image captures. Faecal and blood samples were collected for future analysis. Preliminary results are promising as both data collection methodologies have been successfully compared and all information on the variables obtained has been integrated. It will allow for improving and personalising the lifestyle recommendations given to the population.

Keywords: precision nutrition; artificial intelligence; machine learning; nutritional interventions; disease prevention

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Author Contributions: All authors contributed to the study conceptualization. Material preparation and data curation were performed by G.F., S.R.-T., B.L.P. and I.E.-S.; and the data analysis was performed by S.R.-T., B.L.P., R.T., J.O.-G., E.C.-D.S.P. and I.E.-S. The original draft of the manuscript was written by G.F., S.R.-T., B.L.P., E.C.-D.S.P. and I.E.-S. and all authors commented on previous versions of the manuscript. All authors have read and agreed to the published version of the manuscript.



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Informed Consent Statement: Subjects were insightfully informed about the different stages of the project, both written and oral. Informed consent was obtained for each participant prior to the first evaluation. This document included information about the aim of the study, characteristics, type of questionnaires and samples that were going to be collected, methodology, benefits, risks, and the voluntary nature of the study participation, as well as the data protection policy. It also included a section on the conservation of the remaining samples as a registered collection, in accordance with Spanish legislation (Royal Decree 1716/2011 of 18 November).

Data Availability Statement: A description of the data collected during this intervention is published in <https://doi.org/10.1093/database/baad049> (accessed on 29 January 2024). Data are accessible at <https://github.com/AI4Food/AI4FoodDB> (accessed on 29 January 2024).

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Phenomics and Genomics of Food Selection in Instinctive Nutrition [†]

Rosica Popova ^{1,*} , Konstanza Angelova ² and Bojidar Popov ²



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Abstract: Revealing the genetic background and phenotypes (phenome) of food selection and food preferences is a key factor to developing personalized nutrition in contemporary precision medicine and healthy lifestyles. Food choice in humans has multiple determinants, with complex interactions and the integration of genetic, physiological, psychological and sociocultural factors. Food intake involves ingestion, comprising an initiation phase, a termination/satiation phase and a interingestive period, which are under the genetic control of gastrointestinal neuroendocrine hormones, including cholecystokinin, leptin, ghrelin



and FTO gene, contributing to obesity. Taste modalities are motivational priorities in food choices. The genomics of taste perception and preferences reveal genetic polymorphisms and genetic variations in taste receptors for bitter, sweet, umami, salty, and sour tastes and oleogustus. The integrated multisensory olfactory–gustatory perception, defined as flavor, is modulated by visual, auditory, tactile, and cognitive influences. Dopaminergic activation is crucial for the hedonic principle of ingesting food. The possibility of organisms sending signals to the brain in case of metabolic deficits, which gives rise to specific taste eagerness, is discussed. Based on this aspect, the concept of

instinctive nutrition is formulated.

Keywords: genomics; phenotype; taste perception; food selection; instinctive nutrition

Author Contributions: Conceptualization, R.P. and K.A.; methodology, B.P.; software, R.P.; validation, R.P., K.A. and B.P.; formal analysis, K.A.; investigation, B.P.; data curation, R.P., K.A. and B.P.; writing—original draft preparation, K.A.; writing—review and editing, B.P.; visualization, R.P.; supervision, K.A. All authors have read and agreed to the published version of the manuscript.

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The Insights Gained during the Development of a Personalised Nutrition Mobile App [†]

Barbara Koroušič Seljak ^{*} , Matevž Ogrinc , Andraž Simčič , Eva Valencič , Robert Modic, Gordana Ispirova  and Tome Eftimov 

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Abstract: Tracking food intakes using a mobile app can be an effective approach for some individuals, but it is crucial to consider their personal preferences and health status before adopting this method. Personalized nutrition apps can also serve as an efficient tool for collecting, analysing, and reporting dietary data to support dietary surveys, such as EU Menu by the European Food Safety Authority (EFSA). However, developing an easy-to-use and efficient app requires several essential components. This work presents the insights gained during the development of Eatvisor, a personalized nutrition mobile app. In Slovenia, there was a lack of such tools tailored to national food choices, dietary habits, and recommendations. The app utilizes a food composition database (FCDB) developed in Slovenia; however, the database had many missing compositional data for generic and branded foods. To address this issue, an in-house database management system (DBMS) was developed to support the compilation of different types of data from various sources, such as foreign FCDBs, GS1 Global Data Synchronisation Network (GDSN), database of waste streams, and crowdsourcing, while adhering to the food standards of CEN and respecting the FAIR (Findable, Accessible, Interoperable, Reusable) principles. It is worth emphasizing that compiling a FCDB is a complex task that requires up-to-date knowledge and technical solutions to streamline and expedite the process. Specifically, the DBMS was integrated with semantic resources for organizing knowledge about food (FNS-Harmony ontology linked with FoodOn), as well as food-related regulatory issues. Additionally, methodologies were developed to support missing data imputation in a semi-automated way, and DBMS was designed to manage missing dietary recommendations in a machine-readable format. Moreover, DBMS allows collecting and linking data and knowledge required for personalized advising, including food composition data, biomarker reference intervals, and tailored dietary advice, for both domain experts and machines. Finally, this work evaluates DBMS from the perspective of the data and knowledge required for the development of a personalized nutrition mobile app, such as Eatvisor. The results suggest that DBMS can effectively support the development of a personalized nutrition app, and the methods used can serve as a framework for developing similar apps in other regions.

Keywords: food intake; food composition; database management system; personalized nutrition app



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The Effects of Various Dietary and Exercise Interventions on Continuously Measured Glucose Levels in People with Type 2 Diabetes, and Potential for Personalized Treatment [†]

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Abstract: Introduction: Dietary and physical activity interventions have beneficial health effects for people with type 2 diabetes (T2D). Although the effects of such interventions on long-term changes in glucose levels are well studied in a controlled setting, little is known about the acute effects of lifestyle interventions in a real-life setting and on an individual level. Quantifying the effects of lifestyle on metrics of continuously measured glucose and how these differ between individuals may allow for personalized lifestyle advice for people with T2D. Methods: Forty people with T2D were included in this study. Participants wore a continuous glucose monitor (CGM) for 11 periods of 4 days, of which 3 were control periods (habitual everyday life) and 8 were intervention periods (2× low carbohydrate diet, 2× Mediterranean diet, 2× walking after each meal, and 2× hourly exercise bouts of 5 minutes ('active day')). The CGM metrics used in the ambulatory glucose profile, an internationally recognized standard for interpreting glucose control, were calculated. We used a random effects model to quantify the effect of the four lifestyle interventions on CGM metrics with the participants as a random effect. Results: On average, a low carbohydrate diet, walking after a meal, and an active day resulted in improved CGM metrics, including a lower mean glucose (−0.70, −0.34, and −0.25 mmol/L, respectively) and SD (−0.22, −0.05, and −0.02) and higher time in range (6.9, 3.5, and 3.2%, respectively), the latter being the average percentage of time per day spend in the target glucose range (3.9–10.0 mmol/L). Only the low carbohydrate diet had a positive effect on the coefficient of variation (−1.48), a measure of glucose variability. Also, the magnitude of the effects varied between the interventions. Surprisingly, the Mediterranean diet had adverse effects on all the calculated CGM metrics. Our next step is to investigate inter-individual variation in these intervention effects. Discussion: The low carbohydrate diet, walking after a meal, and active day intervention showed positive, but differential, effects on CGM metrics within 4 days, while the Mediterranean diet showed negative effects. Further analysis on inter-individual variation can be used for personalized lifestyle recommendations, for instance targeted at avoiding high glucose peaks, or reducing variability in glucose levels.

Keywords: continuous glucose monitoring; lifestyle treatment; multilevel model; type 2 diabetes mellitus; personalized advice



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Categorized Dietotype Emergence by Exploratory Factorial Analyses with Axial Nutrition–Health Precision Potential [†]

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Abstract: Introduction: Dietary habits and healthy lifestyles are crucial factors impacting cardiometabolic health and quality of life. Precision nutrition has emerged as a valuable tool to monitor the multiple factors participating in metabolic wellbeing and to examine the possible interactions between diet and health. One such approach involves the use of dimensional reduction methods, which aim to classify subjects into distinct nutritional subgroups or dietotypes based on differential dietary intakes and health outcomes. Methods and Results: A multidimensional exploratory analysis using carefully collected dietary data (Validated FFQ/72 h Recall questionnaires) as well as anthropometric and biochemical determinations from the DIETARY DEAL pilot-study was conducted to define specific dietary profiles. A factorial analysis design was performed, which allowed to identify four distinct clustering factors, characterized as factor 1, or a proto-omnivorous food profile (F1p-O); factor 2, or a pro-vegetarian plant-based diet (F2p-V); factor 3, or a pro-Mediterranean pattern (F3p-M); and factor 4, or a pro-health pescatarian dietary regime (F4p-P). Statistical differences concerning food group consumption (g/d) were found. Thus, F1p-O evidenced higher consumption of fruits, fatty fish, and white and red meat; F2p-V was richer in vegetables, fruits, pulses, and whole grains; F3p-M had olive oil as the most representative food/ingredient; and F4p-P elicited consumption of healthy foods such a vegetables and fatty fish and the avoidance of refined grains, red meats, whole dairy, and ultra-processed solids. After adjusting for potential confounders and energy using the residual method, F1p-O showed a direct relationship with fat-free mass ($\beta = +4.4$; $p < 0.001$), and skeletal muscle mass ($\beta = +2.6$; $p < 0.001$), while the association with F2p-V was the opposite in such somatic markers ($\beta = -2.3$; $p < 0.001$; $\beta = -3.1$; $p < 0.001$; respectively). F3p-M was inversely linked with IL-6 and zinc ($\beta = -0.9$; $p < 0.05$; $\beta = -5.3$; $p < 0.05$, respectively), and F4p-P was coupled with selenium intake in age- and sex-adjusted models ($\beta = +5.6$; $p < 0.05$). Conclusions: Our findings suggest that proto-omnivorous dietary patterns are positively associated with lean mass components, while plantbased diets showed opposite trends. Mediterranean dietary patterns prompted a possible association with anti-inflammatory profiles. These results highlight the potential utility of dimensional reduction methods in understanding the occurrence of qualitative clustered dietotypes relating diet with health outcomes for prescribing precision nutrition.

Keywords: dietotype; precision nutrition; factorial analysis

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Analysis and Prediction of Postprandial Metabolic Response to Multiple Dietary Challenges Using Dynamic Mode Decomposition [†]

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Abstract: Background: In the field of precision nutrition, predicting high-dimensional metabolic response to diet and identifying groups of differential responders are two highly desirable steps towards developing tailored dietary strategies. However, proper data analysis tools are currently lacking, especially for complex settings such as crossover studies. Current methods of analysis often rely on matrix or tensor decompositions, which are well suited for identifying differential responders but lacking in predictive power, or on dynamical systems modelling, which may be used for prediction but typically requires detailed mechanistic knowledge of the system under study. Objectives: To remedy these shortcomings, we aimed to explore dynamic mode decomposition

(DMD), which is a recent, data driven method for deriving low-rank linear dynamical systems from high dimensional data. Methods: To allow integration of complex data from several dietary inputs to the metabolic system, we combine parametric DMD (pDMD) with DMD with control (DMDc). The resulting method allows (i) to predict the postprandial metabolic response of a new diet given only the metabolic baseline and dietary input, and (ii) to identify inter-individual differences in metabolic regulation, useful in determining metabolotypes, i.e., metabolic phenotypes in dynamic data. To our knowledge, this is the first time DMD has been applied to metabolomics data. Results: pDMDc enabled a data-driven construction of low-dimensional dynamical models, able to capture the underlying dynamics of the metabolome after three dietary challenges. We demonstrate the utility and accuracy of the model in a crossover study setting on both measured and simulated data. Using simulated data, metabolic response to a new diet was accurately predicted having trained on four diets, with an average cosine similarity score of 0.6 (SD = 0.27). In measured data, we identified previously published metabolic groups with 100% overlap. Discussion: Accurate predictions via pDMDc require data from several dietary exposures with large variation, which can be costly to collect to confirm the efficacy of the method. A possible remedy is to share data among individuals using the mixed-effects framework. Employing pDMDc paves the way towards using control theory to approach PN by estimating the optimal input given a target metabolite trajectory.

Keywords: precision nutrition; dynamic mode decomposition; differential responders; metabolotypes



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Integrated Analysis of Genomic and GWAS Data to Identify Candidate Genes for Genetic Studies in Flavonoids and Vascular Health: Path to Precise Nutrition for (Poly)phenols [†]

Tatjana Ruskovska ^{1,*} , Filip Postolov ¹ and Dragan Milenkovic ² 



Citation: Ruskovska, T.; Postolov, F.; Milenkovic, D. Integrated Analysis of Genomic and GWAS Data to Identify Candidate Genes for Genetic Studies in Flavonoids and Vascular Health: Path to Precise Nutrition for (Poly)phenols. *Proceedings* **2023**, *91*, 29. <https://doi.org/10.3390/proceedings2023091029>

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Abstract: Good vascular function is one of the key determinants of a healthy heart and preserved neurofunction in advanced age. Previous studies demonstrated vasculoprotective effects of flavonoids, but also inter-individual variability in their action. Several factors have been identified as key determinants of this inter-individual variability, which include sex, age, ethnicity, body mass index, health status, gut microbiome, and genetic factors. Of these, genetic factors are the least studied. The aim of this study was to identify genes that are associated with the vascular health effects of flavonoids and whose polymorphisms could explain inter-individual variability in response to intake of these plant food bioactives. Applying predetermined literature search criteria, we identified five human intervention studies reporting positive effects of flavonoids on vascular function together with global genomic changes analyzed using microarray techniques. Genes involved in vascular dysfunction were identified from genome-wide association studies (GWAS), followed by integrative analyses, functional analyses, and literature search, to identify priority candidate genes for future nutrigenetic studies in flavonoids and vascular health. By extracting data from the eligible human intervention studies, we obtained five sets of differentially expressed genes (DEGs) with $n = 1693$; 717; 554; 2231; and 1401 genes, or a total number of 5807 genes. The number of identified URs varied across the studies, from 227 to 1407 i.e., $n = 227$; 503; 508; 1407, and 993. Searching of the GWAS Catalog revealed 493 genes associated with vascular dysfunction. Further, an integrative analysis of transcriptomic data with GWAS genes identified 106 candidate DEGs and 42 candidate URs. By means of subsequent functional analyses and literature search, as well as additional integrative analyses, we identified the 20 top priority candidate genes: *ALDH2*, *APOE*, *CAPZA1*, *CYP11B2*, *GNA13*, *IL6*, *IRF5*, *LDLR*, *LPL*, *LSP1*, *MKNK1*, *MMP3*, *MTHFR*, *MYO6*, *NCR3*, *PPARG*, *SARM1*, *TCF20*, *TCF7L2*, and *TNF*.

Interrogation of the Variation Viewer and PharmGKB databases identified variants with the highest frequencies and those with pharmacological relevance in the human population. These genes provide important leads to design future nutrigenetic studies for the development of precise nutrition.

Keywords: interindividual variability; genetic polymorphisms; hypertension; atherosclerosis; arterial stiffness; cardiovascular; nutrigenomics; nutrigenetics

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The Palatability Dance—SNPs and Genetic Taste Scores of Umami, Sweet, and Bitter Taste Receptors (TAS1R and TAS2R Genes) [†]

Jean Leite ^{*ID}, Jaqueline Pereira, Marcelo Rogero ^{ID}, Regina Fisberg ^{ID} and Flávia Sarti ^{ID}



Citation: Leite, J.; Pereira, J.; Rogero, M.; Fisberg, R.; Sarti, F. The Palatability Dance—SNPs and Genetic Taste Scores of Umami, Sweet, and Bitter Taste Receptors (TAS1R and TAS2R Genes). *Proceedings* **2023**, *91*, 21. <https://doi.org/10.3390/proceedings2023091021>

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Abstract: Background and objectives: Several factors may account for food behavior, including common genetic variation. Robust evidence shows that specific single-nucleotide polymorphisms (SNPs) are involved in palatability phenotypes. Considering the limited knowledge of these associations in the context of admixed groups, like the Brazilian population, we aimed to investigate associations of SNPs in the TAS1R and TAS2R taste receptor gene families with diet quality. Methods: A sample of 901 individuals ≥ 12 years old from the general population, categorized into age groups (adolescents, adults, and elderly), was interviewed in the Health Survey of Sao Paulo (ISA-Capital). Data on socioeconomic, demographic, and health characteristics were collected, including dietary information from two 24 h recalls in two nonconsecutive days and blood samples. The 24 h recalls were analyzed using the Revised Brazilian Healthy Eating Index (BHEI-R), comprising 12 components referring to food groups, nutrients, and calories from saturated fats, alcohol, and added sugar. Blood samples were genotyped for 255 SNPs in the TAS2R gene family (related to bitterness) and 73 SNPs in the TAS1R (related to sweetness and umaminess). BHEI-R was normally inversed transformed (invBHEIR). After data cleaning and quality control procedures, genotype and phenotype data of 637 individuals were made available for association analysis with invBHEI-R using linear models adjusted for age, age², age \times sex, sex, BMI, and the two first principal components of ancestry. Genetic taste scores (GTs) were derived from the significant SNPs of each gene family and tested for associations. Analysis was performed with the software R version 4.0.2 using a significance level of 0.05. Results: There were 31 SNPs of TAS2R genes and four SNPs of TAS1R genes significantly associated with BHEI-R ($p < 0.05$). GTs were positively associated, and their use increased the model's performance, especially with TAS2R SNPs (r^2 rose from 0.135 to 0.188). Conversely, the estimated effect of the TAS1R score on BHEI-R was 2.02 higher than the TAS2R one. Discussion: Our results show potential genetic influences on diet quality by applying genetic taste scores. Unraveling associations between SNPs and food intake might help guide public policies towards healthier food behavior considering genetic differences, i.e., personalized nutrition.

Keywords: diet quality; palatability; TAS receptors; SNPs; highly-admixed population

Author Contributions: Conceptualization, J.L. and F.S.; Methodology, J.L. and F.S.; Formal Analysis, J.L.; Writing—original draft preparation, J.L.; Writing—review and editing, J.L., J.P., R.F., M.R. and F.S.; Funding acquisition, R.F., M.R. and F.S.; Supervision, F.S. All authors have read and agreed to the published version of the manuscript.

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Tailored Food Recommendations in Facilitating Dietary Change: A Rule-Based Personalized Eating Solution [†]

Jenni Lappi ^{*}, Adil Umer, Jaakko Lähteenmäki and Nesli Sözer



Citation: Lappi, J.; Umer, A.; Lähteenmäki, J.; Sözer, N. Tailored Food Recommendations in Facilitating Dietary Change: A Rule-Based Personalized Eating Solution.

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from personalized nutrition, where dietary advice is tailored to an individual. In personalized nutrition solutions, dietary advice is more and more based on clinical biomarkers, genetics, and the gut microbiome. However, there is evidence that tailored dietary advice based only on personal dietary data is effective in facilitating changes in dietary intakes. Thus, the aim is to create a personalized eating solution: a prototype of data platform recommends foods by linking individual's dietary data with product information via specified rules. **Methods:** The data platform is integrated with an external global food product database and a user interface (UI), and the system structure is: (1) a personal profile, (2) a rules engine with functionality for setting tags and filtering rules, and (3) a knowledge database (food product database). The food product database is integrated via an open API (application programming interface) with the platform, and is utilized to retrieve product information for the filtering rules. When using the platform for the first time, a user must enter demographic data and information about specific dietary criteria and personal preferences. With the permission from the user, the data platform may also retrieve data for the personal profile from other integrated services, including wearable devices. Food recommendations are generated by filtering the product information based on the personal profile and food groups selected by the user. The user can access the food recommendations via a web-based UI. The platform also includes an API, which allows the recommendations to be integrated to existing wellness applications and devices. **Results and Discussion:** The personalized eating solution suitability for use by consumers and ecommerce services will be tested in 2023. A strength is that the solution considers personal preferences to motivate users, such as values related to the consumption of ethic and sustainable products. However, the food recommendation rules rely on formal information about products in the external food database. In the future, the solution could be used for research, commercial, and healthcare purposes in facilitating dietary changes to promote health and wellbeing.

Keywords: personalized eating; food recommendation; platform prototype

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Abstract: Background and objectives: A concept of personalized eating originates

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Comparison of Metabolic Age and Health-Related Quality of Life (HRQoL) in Three Different Pro-Inflammatory Conditions Depending on Weight [†]

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Comparison of Metabolic Age and Health-Related Quality of Life (HRQoL) in Three Different Pro-Inflammatory Conditions Depending on Weight. *Proceedings* 2023, 91, 102. <https://doi.org/10.3390/proceedings2023091102>

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Abstract: Background and objective: Systemic autoimmune diseases, viral infections (COVID-19) and obesity/metabolic syndrome (MS) are all characterized by a chronic inflammatory state with some putative shared physiopathological features. Biological age and HRQoL approaches have been applied as human health and aging indices. The objective of the META-INFLAMMATION study was to analyze the differences and/or similarities between subjects with systemic lupus erythematosus (SLE), long-COVID and obesity/metabolic syndrome, which are all recognized inflammatory conditions, and to compare metabolic age and HRQoL depending on weight status in those patients. Methods: A total of 232 participants (≥ 18 years) were recruited whose anthropometric data were collected (height, weight, bioelectrical impedance analysis, waist circumference, hip circumference and blood pressure). The patients answered different questionnaires related to socio-demographic data, metabolic history, lifestyle (physical activity, sleep habits and nutrition) and HRQoL. Metabolic age and HRQoL (SF-12) were assessed with validated tools. Differences and interactions among the three types of diseases and body mass index (BMI) as stratified by p50 were studied using a 3×2 (diseases \times adiposity) factorial ANOVA design and with appropriate post hoc contrasts. Results: The analyses revealed significant differences in biological age ($p < 0.001$) between each disease and BMI (high vs. low). Interestingly, the type of disease and BMI showed an interaction concerning biological age ($p < 0.05$). Regarding HRQoL, significant differences ($p < 0.01$) were found between each pro-inflammatory condition and between both BMI groups for the PCS (Physical Component Summary), while only the MCS (Mental Component Summary) showed statistical differences among diseases ($p < 0.001$) but not for BMI ($p = 0.42$). Additionally, the PCS evidenced a statistically significant modification of the effect ($p < 0.01$) depending on the type of disease as conditioned by the BMI (high vs. low) but not for the MCS ($p = 0.13$). Discussion. Featuring precision indices such as biological age and HRQoL in patients with SLE, long-COVID, and obesity/metabolic syndrome and interactions with ponderal status enables better monitoring of these inflammatory diseases. Metabolic individualization and the early prevention of associated complications can be achieved by using validated biomarkers and scores, seeking the personalization of therapeutic management with clinical precision.

Keywords: lupus; long COVID; obesity; inflammation; quality of life

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A.C.-S. and R.C.; funding acquisition, J.A.M. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the clinical trial is not finished.

Conflicts of Interest: The authors declare no conflict of interest.

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Local Food Systems under a Global Influence: How Should We Holistically Assess Evolving Food Systems? [†]

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Abstract: In order to comprehend the impact of globalization on local food systems, it is crucial to consider sociohistorical, socioeconomic, and sociocultural trajectories, accompanied by long-term and cross-sectional monitoring. To achieve this objective, it is necessary to develop research protocols that enable the comparative evaluation of diets from the perspective of dietetics and nutrition, as well as local representations of food. Within the framework of an interdisciplinary and international OHM (Human-Environment Observatories) research network, a multidisciplinary team of researchers specializing in ethnecology, health, nutrition, ecotoxicology, anthropology, and sociology was assembled. The network's role is to conduct long-term studies on human-influenced ecosystems that are susceptible to socio-ecosystemic crises, such as those related to food and health. The consortium comprised researchers working within five OHMs, namely Estarreja (Portugal), Téssékéré (Senegal), Littoral-Caraïbes (Guadeloupe, France), Oyapock (French Guiana, France), and Nunavik (Québec, Canada), which focus on five distinct socio-ecosystems. Results: A cross-sectional data collection protocol was developed, consisting of a two-part questionnaire. Part 1 involves a structured 24 h dietary recall (24HR) that deviates from standard 24 h questionnaires by excluding portion sizes, instead focusing on food acquisition strategies and the degree of food item transformation. Part 2 encompasses a semi-structured interview guide that explores the concept of "eating well," barriers and facilitators to achieving it, changes in diet and dietary habits, and the connection between diet and health. This questionnaire captures, in a single session, the food items that individuals consumed the previous day, including their origin and level of transformation, as well as the associated perceptions regarding those food items and the overall diet. This approach enables the collection of data that facilitate the assessment of factors influencing diet from both the researchers' point of view (i.e., etic perspective) and that of local populations (i.e., emic perspective). The questionnaire thus adopts a holistic approach, enabling us to analyze the links that populations establish between the socioecosystemic crises they have undergone (or are currently undergoing), their health and the evolution of their food systems.

Keywords: nutrition and food transition; one health; globalization; chronic diseases; research protocols



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The Impact of Adolescents' Food Purchasing on Overall Dietary Quality Differs by Socioeconomic Status [†]

Sarah Shaw ^{1,*}, Sarah Crozier ¹, Cyrus Cooper ¹, Dianna Smith ², Mary Barker ¹ and Christina Vogel ^{1,3}



Citation: Shaw, S.; Crozier, S.; Cooper, C.; Smith, D.; Barker, M.; Vogel, C. The Impact of Adolescents' Food Purchasing on Overall Dietary Quality Differs by Socioeconomic Status. *Proceedings* **2023**, *91*, 407. <https://doi.org/10.3390/proceedings2023091407>

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Abstract: During adolescence, many young people commence making more independent food purchases. Subsequently, these independent food choices will increasingly contribute to their overall diet quality; little is known, however, about this relationship. This study aimed to (1) understand the role adolescents' independent food purchases play in their overall diet quality and (2) explore if these relationships vary according to socioeconomic status (SES). A one-week observational study was conducted with 108 adolescents, aged 11–18 years, from Hampshire, UK. Participants completed a demographic questionnaire and a validated 20-item Food Frequency Questionnaire, which assessed diet quality. Participants also used a mobile phone app to record their food purchases. The healthfulness of

food purchases was assessed against UK healthy eating guidelines. Linear regression models were used to investigate associations between the healthfulness of food purchases and diet quality. An interaction term was used to determine the modification effect of SES. During the study week, 583 food/drink items were purchased on 273 food-purchasing occasions by 80 participants. The majority of purchases ($n = 359$, 62%) were coded as 'not adhering' to the UK Eatwell Guide, 30% were coded as 'adhering' and 8% were coded as uncategorised foods. No notable differences were observed in the healthfulness of food purchases according to age, gender, ethnicity or SES. Healthier food purchasing was associated with better diet quality (β 0.52, (95% CI 0.06, 0.99) $p = 0.03$); the results were attenuated after adjustment (β 0.41, (95% CI -0.08 , 0.91) $p = 0.10$). Interaction analysis showed that the healthfulness of purchases was more strongly associated with diet quality among young people of lower SES ($p = 0.06$). Discussion: The majority of purchases made by adolescents were categorised as 'not adhering' to healthy eating guidelines. For adolescents experiencing disadvantage, these food choices had a more detrimental impact on their overall diet. We speculate this is because independent food choices represent a greater proportion of the foods consumed by these adolescents compared to those who are less disadvantaged. Finding ways to support more healthful independent food choices among adolescents, particularly those from disadvantaged backgrounds, is important to improve dietary quality and reduce inequalities.

Keywords: adolescents; diet; food purchasing; inequalities

Author Contributions: Conceptualization, S.S. and C.V.; methodology, S.S. and C.V.; validation, S.C. and C.V.; formal analysis, S.S. and S.C.; data curation, S.S.; writing—original draft preparation, S.S.; writing—review and editing, S.C., D.S., C.C., M.B. and C.V.; supervision, S.C., D.S., C.C., M.B. and C.V.; project administration, S.S.; funding acquisition, S.S., M.B. and C.V. All authors have read and agreed to the published version of the manuscript.

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Switching Mediterranean Consumers to Mediterranean Sustainable Healthy Dietary Patterns (SWITCHtoHEALTHY): Study Protocol of a Multicentric and Multi-Cultural Family-Based Nutritional Intervention Study [†]

Lorena Calderón-Pérez ¹, Djamel Rahmani ², Metin Güldas, ³, Asmaa El Hamdouchi ⁴, Simona Mincione ⁵ and Noemí Boqué ^{1,*}



Citation: Calderón-Pérez, L.; Rahmani, D.; Güldas, M.; El Hamdouchi, A.; Mincione, S.; Boqué, N. Switching Mediterranean Consumers to Mediterranean Sustainable Healthy Dietary Patterns (SWITCHtoHEALTHY): Study Protocol of a Multicentric and



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Abstract: The population from Mediterranean countries is abandoning the Mediterranean traditional dietary and lifestyle pattern (MD), moving to unhealthier habits because of profound socio-economic changes. There is a lack of adequate study protocol for inducing a positive dietary, environmental and lifestyle behavior in the family setting. SWITCHtoHEALTHY aims to demonstrate the efficacy of a multi-component nutritional intervention to improve the adherence of families to MD in three Mediterranean countries. A parallel, randomized, controlled trial will be conducted in 480 families with children and adolescents aged 3–17 years from Spain, Morocco and Turkey over 12 months. The multi-component intervention will combine digital interactive tools, hands-on educational material and easy-to-eat healthy developed snacks for children. Through the SWITCHtoHEALTHY App, the parents will receive personalized weekly meal plans and ideas and suggestions about dinner and weekend preparation taking into account the children's lunch, promoting a balanced food intake for all family. The engagement of all the family will be prompted by using a life simulation game. In addition, a set of activities for adolescents based on a learning-through-play approach to be carried out within the family and at the research centers will be developed through co-creation. Innovative and sustainable plant-based snacks will be introduced to the children's dietary plan as healthy alternatives for between meals. By using a full-factorial design, families will be randomized into eight groups (one control and seven intervention) to test the independent and combined effects of each component. Three visits will be performed, including one pre-assessment (baseline), one at the beginning (month 9) and one after the 3-month intervention (month 12). The impact of the intervention on diet quality, economy and the environment, as well as classical anthropometric parameters and vital signs, will be assessed at each visit. The main outcome will be adherence to the MD assessed through MEDAS in adults and KIDMED in children and adolescents. This protocol describes the rationale, eligibility criteria, methods, recruitment strategies and analysis plan of a novel multi-component intervention. SWITCHtoHEALTHY will provide new insights into the use of sustained models for inducing dietary and lifestyle behavior changes in the family setting. It will allow for generating, boosting, and maintaining the switch to a healthier MD dietary pattern across the Mediterranean area.

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Hygienic Assessment of the Proper Nutrition for Secondary School Students [†]

Akmaral Baspakova 



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Abstract: The health of the younger generation in modern socio-economic conditions is characterized by an increase in the prevalence of functional abnormalities and chronic diseases. Of the total number of factors that have a negative impact on the health of adolescents, the impact of schooling and violating the rules of nutrition are the top priority. The etiopathogenetic role of nutrition as a risk factor in modern conditions determines the nature of the development of alimentary-dependent pathologies in children and adolescents,

which include anemia, iodine deficiency conditions, diseases of the gastrointestinal tract, etc. Therefore, optimal nutrition in childhood and adolescence will contribute to the prevention of diseases, proper physical and neuropsychic development, and increase the adaptive capabilities of the body. The cross-sectional design of the study was used to collect data from adolescents aged 13 to 15 years. Improbability quota sampling was used for data collection. Data processing was carried out using SPSS version 25.0. Mean values and standard deviations were calculated for continuous variables, while categorical variables were analyzed using frequencies and percentages. The chi-square criterion was used to determine the relationships between categorical variables. A p -value < 0.05 was considered statistically significant in all analyses. The study covered 1254 adolescents

aged 13–15, of which 46.3% were boys and 53.7% were girls. From the data presented, it was found that 37.3% of adolescents did not comply with the diet, and 62.5% kept to the diet. In total, 37.6% of first and second hot meals were consumed 2–3 times a day, and 35.2% were consumed only once a week. There was no statistically significant relationship between nutrition and obesity ($p = 0.362$) or between dietary diversity and nutritional status ($p = 0.549$). The results of this study on the proper nutrition for adolescents shows that secondary school students do not follow the proper diet and often eat fast food.

Keywords: adolescents; proper nutrition; secondary school; dietary diversity; nutritional status

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Cultural Adaptation of a Text Message Library Designed to Support Diet, Activity and Weight Management Behaviour in the Postpartum Period in the UK: The Supporting MumS (SMS) Study [†]

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Abstract: The Supporting MumS library of text messages was developed with extensive personal and public involvement (PPI) to help with postpartum weight management and was successfully tested in a feasibility study in Northern Ireland. Before conducting an effectiveness trial, further PPI work was needed to ensure that the dietary and lifestyle advice offered within the SMS text message library was acceptable and culturally relevant for a wide range of women across the United Kingdom (UK). Recruitment was facilitated by existing community networks that helped capture a culturally diverse group of postpartum women who have struggled with their weight. Nineteen women took part in the PPI exercise: n = 4 African–Caribbean (living in London), n = 8 Asian (Bradford), n = 7 white (Scotland). The PPI work followed an iterative process with initial online group discussions, where selected text messages were reviewed and feedback was sought on their language, tone and cultural relevance. This was followed by message adaptation and re-review. Following initial group discussions to understand the main areas for adaptation, PPI work was carried out with individual mums who reviewed the entire library of text messages and provided feedback on all adaptations. Mums liked the humour and the supportive tone of the messages and approximately 15% of the messages were left unchanged. Suggested edits to ensure the messages were acceptable and relevant to women from a range of cultural backgrounds were minor in nature. Suggestions provided by PPI representatives were mainly in relation to broadening the relevance of snack ideas, recipes, food preparation advice, shopping habits (e.g., click and collect services) and workout ideas. Additional feedback included removing colloquialisms and idioms, the meaning of which may be confusing for somebody not familiar with them or a non-native English speaker (e.g., ‘run out of steam’). Personal and Public Involvement provided helpful suggestions for the cultural and regional adaptation of a lifestyle text message intervention in the postpartum period. The effectiveness and cost-effectiveness of the Supporting MumS study will be tested in a UK-wide trial.

Keywords: postpartum; weight management; personal and public involvement

Author Contributions: Conceptualization, M.M., S.B. and E.S.; methodology, E.S., L.C., E.A., S.A., S.B. and M.M.; formal analysis, E.S. and M.M.; investigation, E.S., L.C., E.A., S.A. and S.B.; resources, M.M., S.B. and P.H.; data curation, E.S. and L.C.; writing—original draft preparation, E.S.; writing—review and editing, L.C., E.A., S.A., S.B., P.H. and M.M.; supervision, M.M., S.B. and P.H.; project administration, M.M.; funding acquisition, M.M., S.B. and P.H. All authors have read and agreed to the published version of the manuscript.



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Food Neophobia Is Associated with Food Texture Pickiness and Lower Liking of Foods with Spongy Texture among Finnish Consumers [†]

Ella Koivuniemi ^{1,*}, Terhi Pohjanheimo ² and Anu Hopia ¹



Citation: Koivuniemi, E.; Pohjanheimo, T.; Hopia, A. Food Neophobia Is Associated with Food Texture Pickiness and Lower Liking of Foods with Spongy Texture among Finnish Consumers. *Proceedings* **2023**, *91*, 272. <https://doi.org/10.3390/proceedings2023091272>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Food texture is an important factor in the liking and choice of food. Food neophobia, the avoidance of unfamiliar foods, has been linked with sensitivity to textural properties of food. The objective of this study was to investigate the associations between food neophobia, pickiness to food textures and the liking of food items with diverse textural properties among Finnish consumers. Finnish adults aged 18–45 years were recruited. The level of food neophobia was assessed with Food Neophobia Scale (FNS). Participant's agreement to a statement "I'm very picky regarding food textures" was measured by a 7-point Likert scale, and the degree of liking of various food items, including vegetables, fruits and berries (e.g., mushroom, cloudberry), grain products (e.g., rye bread, oatmeal), dairy (e.g., 'squeaky cheese', smoothie) and other foods (e.g., tofu, other plantbased proteins, shrimp) by using a 9-point hedonic liking scale. Participants were divided into three groups based on the mean (M) and standard deviation (SD) of the FNS scores: individuals with FNS scores $< M - 0.5 \times SD$ were considered 'neophilic', those with scores between $M \pm 0.5 \times SD$ were 'neutral' and those with scores $> M + 0.5 \times SD$ were 'neophobic'. Results: Consumers (N = 135, of which 88% were females) responded to the questionnaires. Of the respondents, 32% were neophobic, 34% neutral and 34% neophilic. Neophobia was associated with self-reported pickiness to food texture; neophobics were pickier compared to neophilics and neutrals ($p < 0.001$). Neophobics showed lower liking of tofu ($p = 0.015$), other plant-based proteins ($p = 0.008$), 'squeaky cheese' ($p = 0.024$) and shrimps ($p = 0.004$) compared to neophilics. Furthermore, the neutral group had a lower liking of smoothies ($p = 0.046$) and tofu ($p = 0.004$) compared to neophilics. No other differences in food liking were shown between the groups. Neophobics were less likely to have a university-level education than neutrals and neophilics ($p = 0.003$); age and sex did not differ between the groups. Adult consumers with food neophobia showed pickiness to food textures and lower liking of several food items with textural properties that are known to be challenging and can be described as spongy. The textural properties of foods should be considered more frequently when developing new foods to ensure more enjoyable food experiences for consumers.

Keywords: food neophobia; food texture; pickiness; sensory sensitivity; food choice

Author Contributions: Conceptualization, E.K. and T.P.; methodology, E.K., T.P. and A.H.; validation, E.K. and T.P.; formal analysis, E.K.; investigation, E.K. and T.P.; resources, A.H.; data curation, E.K.; writing—original draft preparation, E.K.; writing—review and editing, T.P. and A.H.; supervision, A.H.; project administration, A.H.; funding acquisition, A.H. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: Author T.P. was employed by the company Aistila Oy. The remaining authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Potentially Misleading Effect of Meat Terminology on Plant-Based Meat Alternative Labels [†]

Linsay Ketelings ^{1,2,*}, Stef Kremers ³, Remco Havermans ² and Alie de Boer ¹



Belgrade, Serbia, 14–17 November 2023.

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[†] Presented at the 14th European Nutrition Conference FENS 2023,

Abstract: The importance of meat alternatives is expected to grow significantly in the future. Resulting from their increasing popularity, a political debate has been ongoing in the European Union, among other jurisdictions, concerning regulatory requirements of the labelling of meat alternatives. A restriction of meat terminology on the labels of meat alternatives was proposed, as these labels are allegedly misleading. However, limited research exists that provides insight into consumer perspectives on this presumed confusing or even misleading potential of meat alternatives. Therefore, the aim of this study is to investigate whether meat-like terminology used on meat alternative labels have a confusing or misleading effect on Dutch consumers. The participants were presented with a reaction time test, where they were asked to categorise food products (based on their labels) as either animal-based or plant-based. There was a total of four categories: (1) vegetables, (2) meat, (3) meat alternatives with meat terminology, and (4) meat alternatives not referring to meat. The participants categorised the presented stimuli as fast as possible. The participants were excluded from the study if they did not speak the Dutch language fluently or if they followed a vegan diet. Additionally, in a short questionnaire, the participants were asked for their demographic information and about their perception towards meat alternative labelling. The preliminary results show that the participants had an increased response latency when classifying plant-based products with meat terminology as plant-based products compared to when non-meat names were used for plantbased meat substitutes. Also, the participants did make significantly more errors when categorising plant-based meat alternatives with names referring to meat products. In conclusion, the increased time needed and an increased number in mistakes when classifying meat alternatives with meat terminology could support the argument that the terminology is confusing when only the name is shown to consumers. Nevertheless, other factors such as packaging design, labels and place in the supermarket can significantly reduce this confusing aspect. These results can inform legislators and policymakers in deciding on labelling requirements for plant-based meat alternatives.

Keywords: meat substitutes; European food law; food information; consumer behaviour

Author Contributions: Conceptualization: L.K., S.K., R.H. and A.d.B.; Methodology: L.K. and R.H.; Formal Analysis: L.K. and R.H.; Writing—original draft preparation: L.K.; Writing—review and editing: S.K., R.H. and A.d.B.; Supervision: S.K., R.H. and A.d.B. All authors have read and agreed to the published version of the manuscript.

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Individual Resilience—Recent Elaborations on the Impact of Diet, Physical Activity and Sleep [†]

Friederike Elsner * and Carola Strassner



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Abstract: In the face of an external crisis like COVID-19, some people experience severe mental health issues whereas others remain healthy. Research on individual resilience is concerned with precisely this phenomenon. It investigates the underlying question of why some people remain healthy in the face of adversity and danger while others exposed to the same or similar circumstances are unable to maintain their mental health. Resilience can be taught and strengthened and is often promoted through psychological interventions, although these interventions are not necessarily effective for everyone. Studies suggest growing evidence for the relationship between certain lifestyle factors (diet, physical activity and sleep) and mental health, although an overview is lacking. Therefore, we aim to present the current state of knowledge on the influence of diet, physical activity and sleep on individual resilience. We conducted a rapid literature search on the PubMed database using relevant search terms. Studies were only included if resilience was assessed with a resilience scale. After the selection procedure, we included nine articles for individual resilience and diet, 17 for individual resilience and physical activity and 10 for individual resilience and sleep. The results show that a Mediterranean dietary pattern, a high diet quality and the consumption of fruits and vegetables are positively associated with resilience. In contrast, a Western dietary pattern seems to have negative implications. Physical activity, good sleep quality and adequate sleep duration were positively associated with resilience, while low sleep quality and increased sleep disturbances were associated with lower resilience. As almost all the included studies were of a cross-sectional nature, a causal relationship cannot be inferred. However, the potential influence of diet, physical activity and sleep on resilience can be supported by psychological, (neuro)biological and social factors.

Keywords: mental health; well-being; lifestyle factors

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Socioeconomic Inequalities in Food Habits among Children Living in North Macedonia [†]

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Abstract: Nutritional factors are major drivers of childhood obesity and increased risk of noncommunicable diseases in adulthood. Therefore, understanding family food habit patterns and differences are important for public health policy planning. Drawing from a nationally representative sample of children in North Macedonia (MKD), the aim of our study was to explore the association between children's food-related behaviours and family socioeconomic status (SES). As part of the fifth round of the World Health Organization (WHO) European Childhood Obesity Surveillance Initiative (COSI), a cross-sectional study was conducted with MKD children and their parents/caregivers. Each child's daily food habits (daily consumption of fresh fruits and vegetables, soft drinks, and breakfast) were assessed and categorised as either healthy or less healthy. Family SES was ascertained by a self-reported level of parental education attainment (low, medium, and high) and family-perceived wealth (low, medium, and high), following the methodology employed in previous WHO COSI studies. A multivariate multilevel logistic regression analysis was employed to estimate the odds ratios (ORs) of having a healthy food habit as a function of family SES while controlling for sex and place of residence. Results: The sample was composed of 3221 7-year-old children (boys = 1590 and girls = 1631), with the majority living in urban areas (75.2%). Healthy food habits were as follows: eating breakfast every day (75.4%), eating fresh fruit every day (40.5%), eating fresh vegetables every day (36.2%), and consuming sugar-containing soft drinks <3 days per week (59.2%). Higher family-perceived wealth was predictive of a greater likelihood of eating breakfast (OR = 1.18; 95% confidence interval [CI] = 1.03–1.34) and fresh fruits (OR = 1.19; 95%CI = 1.07–1.34) every day. Higher parental education was predictive of a greater likelihood of eating breakfast (OR = 1.46; 95%CI = 1.29–1.66) and vegetables (OR = 1.12; 95%CI = 1.01–1.24) every day and consuming sugar-containing soft drinks <3 days per week (OR = 1.21; 95%CI = 1.09–1.35). Our findings show that while most MKD children practice at least one healthy food habit, there are evident dietary disparities among children related to family SES. These SES patterns are valuable information for public health policymakers to consider as they work to reduce health inequalities with targeted public health and economic actions.

Keywords: food habits; socioeconomic status (SES)

Author Contributions: Conceptualization, A.S., L.S.W., K.M. and I.S.; methodology, I.S.; validation, A.S., I.S. and L.S.W.; formal analysis, L.S.W.; investigation, I.S., L.S.W. and A.S.; resources, I.S. and L.S.W.; data curation, A.S. and L.S.W.; writing—original draft preparation, A.S. and L.S.W.; writing—review and editing, A.S., L.S.W., I.S. and K.M.; supervision, I.S.; project administration, I.S.; funding acquisition, I.S. All authors have read and agreed to the published version of the manuscript.

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How to Nudge a Modern Consumer towards Healthier Food Choices [†]

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Abstract: Food environments have a major influence on consumers' food choices. The increasing abilities and accessibility of technology have caused food choices to be made in digital environments. Contemporary consumers increasingly select and purchase foods via web-based and mobile applications, where their perceptions and food choices are mediated entirely through user-interface (UI) designs. Therefore, online services offer a great opportunity for choice architects to develop new digital nudging strategies that could promote healthier food choices. At the conference, we present the results of two recently conducted studies to test two digital nudging strategies: the first was conducted within an experimental online grocery store and the second was conducted using a mobile application for food (specifically snacks) tracking. A review of existing digital nudging strategies used on online grocery stores was provided to demonstrate why research on the potential impacts of digital environments on food choices is needed. In addition, two different digital nudging strategies were presented, providing details about the applied human–computer interaction principles. The first nudging strategy, implemented within an experimental online grocery store, is based on the re-positioning of product categories and of food products within those categories based on the content of a specific nutrient (specifically dietary fibre). The second strategy, implemented within a mobile application, exploits the influence of UI, implemented as background images of either healthy or unhealthy snacks, on snack choices. In addition, the mobile app was published as an open-access app; thus, further studies investigating the impact of UI can be conducted and the easy collection of data is facilitated. The results of both studies, performed in different digital settings and in two countries (Slovenia and Australia), were presented. The main findings suggest that further investigation of this research field is warranted, and that strategically implementing digital nudging strategies in online environments may promote healthier food choices. Lastly, this research provides insights (i) for consumers on how UIs can affect food choice decisions, (ii) for choice architects in the health-promotion research area, as it may inform the development of interventions to promote healthy food choices, and (iii) for policy makers regarding whether regulations are needed to protect consumers in online food choice settings.

Keywords: digital nudging; choice architecture; choice behavior; food choice

Author Contributions: Conceptualization, E.V., B.K.S., T.B., C.E.C. and E.B.; methodology, E.V., B.K.S., T.B., C.E.C. and E.B.; writing—original draft preparation, E.V.; writing—review and editing, B.K.S., T.B., C.E.C. and E.B.; supervision, B.K.S., T.B., C.E.C. and E.B.; funding acquisition, B.K.S., T.B. and C.E.C., All authors have read and agreed to the published version of the manuscript.

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Weight Management Challenges and Facilitators in Adult Maltese Women [†]

Nicole Zammit * and Claire Copperstone



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Abstract: Obesity and overweight rates in Malta are

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high. Recent studies report that nearly one third of Maltese women are affected by obesity and another third are in the overweight category, respectively the causes of obesity are complex and multifactorial, highlighting the need to further understand the main issues within a specific target population to develop effective and sustainable weight loss strategies. The overall aims of this local study were to investigate the main weight management challenges and facilitators experienced by Maltese women. An adapted, translated, and anonymised quantitative survey targeting adult Maltese females aged 18–65 years was shared in local media from November till December 2020. The questionnaire addressed weight loss (WL) strategies utilised; WL influences; barriers to WL (using close-ended questions); and suggestions for weight loss programmes (WLP) (using open-ended questions). Results were analysed using SPSS software (IBM, version 27). Data analysis included Chi-squared, Friedman and Kruskal–Wallis tests. Results: 193 respondents returned the survey. The majority (n = 93, 48.2%) were aged between 18–29 years; over half had a tertiary education level (n = 112, 58%), and they had a median Body Mass Index (BMI) of 25.3 kg/m². The three most commonly reported weight loss methods were ‘calorie controlled’ (n = 129, 66.8%), ‘fasting’ (n = 61, 31.6%), and the ‘Mediterranean diet (based on local dietary guidelines)’ (n = 51, 26.4%). Respondents thought that ‘drinking more water’; ‘consuming smaller food portions’; and ‘removing sugary products’ helped WL, whereas ‘being abroad’ or being ‘sad or stressed’ did not (mean rating scores [MRS]: 4.19, 4.13, 4.11, 3.97, 3.90, respectively). The main barriers to exercise were ‘lack of motivation’; and ‘finding it difficult to stick with routine’ (MRS: 3.24 and 3.16). Suggestions for WL included receiving more educational information (n = 20, 31.2%), making WL/exercise programmes affordable (n = 14, 21.9%), and receiving more support (n = 7, 10.9%). This local study pinpoints issues such as cost, motivation, and mental wellbeing considerations. The development of frameworks for further guidance and support on sustainable and healthy weight loss is suggested.

Keywords: weight management; Malta

Author Contributions: Conceptualization, C.C.; methodology, C.C. and N.Z.; data curation; N.Z.; formal analysis, N.Z.; writing-original draft preparation, N.Z.; writing-review and editing, C.C.; All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available in Open Access Repository University of Malta (OAR@UM) at <https://www.um.edu.mt/library/oar/handle/123456789/86336> (accessed on 14 November 2023).

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Exploring the Link between Hedonic Hunger and Obesity among Psychology Students [†]

Fatma Özsel Özcan Araç * and Rozerin Özperçin



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Abstract: In today's world, it is increasingly evident that the energy-dense and highly palatable foods that we are exposed to have a stimulating effect on the hedonic and

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homeostatic systems that regulate energy balance. As a result, food consumption extends beyond homeostatic needs, leading to a gradual increase in the prevalence of obesity. This study aimed to explore the potential association between hedonic hunger and obesity among psychology students in Turkey. A total of 167 participants from various universities with psychology departments participated in the research. The participants completed questionnaires assessing socio-demographic characteristics, dietary habits, health information, prior dieting experiences, height, weight, and body mass index (BMI). Additionally, the Nutrient Power Scale and Three-Factor Questionnaire were employed to evaluate hedonic hunger, while an online-based Eating Scale questionnaire was administered. Data analysis was conducted using the SPSS 27.0 software. The results revealed a positive correlation between body mass index (BMI) values and the total scores of the Nutrient Power Scale, indicating a tendency towards hedonic hunger among individuals with higher BMI values. However, this correlation did not reach statistical significance ($p > 0.05$). Nevertheless, statistically significant differences were observed between BMI and sub-factors of food availability and tasting food ($p < 0.05$), suggesting a heightened hedonic response to food with increasing BMI. Moreover, individuals with elevated BMI exhibited higher scores on the Binge Eating Disorder Inventory (BDI) and its sub-factors, indicating greater sensitivity to the food environment. Furthermore, participants with hedonic hunger displayed significantly higher total scores on the Three-Factor Eating Scale than those without hedonic hunger ($p < 0.05$). This study confirms the hypothesis that obese individuals exhibit a higher level of hedonic hunger compared to their non-obese counterparts among psychology students. The significant correlation between BMI and specific hedonic hunger sub-factors underscores the potential influence of hedonic mechanisms on food consumption patterns. These findings contribute to our understanding of the psychological factors associated with obesity, suggesting the relevance of hedonic hunger as a potential target in interventions and prevention strategies addressing obesity in student populations.

Keywords: hedonic hunger; obesity; eating disorder

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Gender-Specific Dietary Patterns of Energy Drink Consumption among Adolescents from Southern Poland [†]

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Belgrade, Serbia, 14–17 November 2023.

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Abstract: Energy drinks (EDs) are non-alcoholic beverages with a high content of caffeine and other ingredients. Recently, an increased consumption of EDs has been noted among teenagers and young adults. However, in Poland, there are no specific laws restricting access to EDs among children and adolescents. The aim of this study was to investigate gender-specific dietary patterns in the consumption of EDs among adolescents from southern Poland. A cross-sectional survey including 518 participants (girls, 51%; boys, 49%; mean age, 17.15 ± 0.60 years) was conducted in the years 2014–2015. Using a cluster analysis, k-means were grouped separately for boys and girls by applying the Manhattan distance between two vectors (city blocks). Clusters were distinguished based on two factors: the amount and frequency of ED consumption. Three clusters, each corresponding to different ED consumption patterns, were identified for boys and girls: cluster 1, never; cluster 2, 125 mL EDs less than 1–2 times a week; and cluster 3, 250 mL EDs 5–6 times a week. Overall, almost 90% of participants reported ED consumption (currently and in the past). Energy drinks were consumed at least once a week by 22.1% of boys and 12.8% of girls ($p = 0.0003$). Boys from cluster 3 were more likely to drink isotonic drinks, sweet fizzy drinks, and cola drinks than boys from the other clusters ($p < 0.05$). They were also more likely to use other stimulants, such as cigarettes and alcohol, when consuming EDs when compared with the other groups ($p < 0.05$). A similar pattern was observed for girls, with girls from cluster 3 being more likely to consume sweet beverages and to consume EDs when using alcohol and cigarettes when compared with girls from the remaining clusters ($p < 0.05$). The findings support the results of other authors in terms of the more frequent consumption of EDs by boys. However, in contrast to other studies, the patterns of ED consumption did not differ between boys and girls. In this study, the consumption of EDs was associated with several negative health behaviors. This shows that specific policy-level measures are needed, such as reducing the availability of EDs among adolescents.

Keywords: Energy drinks; adolescents; dietary patterns; eating behavior

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Validation of the Chilean Version of the Yale Food Addiction Scale 2.0 in Clinical and Non-Clinical Samples [†]

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Abstract: There is growing scientific evidence regarding the biological, psychological, and behavioral parallels involved in addiction and excessive food consumption. The Yale Food Addiction Scale 2.0 (YFAS2.0) is currently the only validated measure to operationalize addictive eating behavior. This scale has not been validated in the Chilean population; therefore, the aim of this study was to evaluate the psychometric properties of the culturally adapted version of YFAS2.0 for the Chilean population. An observational, analytical, and cross-sectional study was carried out. Sampling was non-probabilistic, by convenience. N = 466 participants were recruited, of which n = 160 formed the clinical sample (two clinical centers that specialized in the management of chronic non-communicable diseases), and n = 306 formed the non-clinical sample (universities and private companies). The adapted Chilean version of YFAS2.0 was applied using the online REDCap platform, then anthropometric measurements were made, and the body mass index (BMI) was calculated. The internal consistency of the YFAS2.0 items was estimated (Kuder–Richardson formula 20), and the structure of the scale was confirmed using a confirmatory factorial analysis. The association between the number of addictive symptoms and BMI was also evaluated. The sample was composed mainly of women (62.7%), with an average age of 35.7 ± 15.8 years. The prevalence of food addiction was 13.1% and 10.1%, and the number of addiction symptoms presented was 2.3 ± 2.6 and 2.1 ± 2.8 in the clinical and non-clinical samples, respectively. The Chilean version of YFAS2.0 presented good internal consistency (KR20 = 0.85), and the factor analysis supports the one-factor structure, similar to the original version, showing adequate fit indexes (CFI was 0.969; RMSEA was 0.063) with all the factor loadings greater than 0.57. Additionally, a slight positive correlation was observed between number of symptoms and BMI ($\rho = 0.23$, $p = 0.012$). The adapted Chilean version of YFAS2.0 was validated in clinical and non-clinical samples, presenting good psychometric properties, so it can be considered for research studies on food addiction in the Chilean population.



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Keywords: Yale Food Addiction Scale 2.0; validation; factor analysis; food addiction

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C.C., A.V. and M.R.; All authors had full access to all data in the study and take responsibility for the

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Food Information Is Mostly Not Well Accessible to Consumers with a Visual Impairment—An Exploratory Phenomenological Study[†]

Alie de Boer *¹ and Alissa Schrijnemaekers



Citation: de Boer, A.; Schrijnemaekers, A. Food Information Is Mostly Not Well Accessible to Consumers with a Visual Impairment—An Exploratory Phenomenological Study. *Proceedings* **2023**, *91*, 184. <https://doi.org/10.3390/proceedings2023091184>

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Abstract: Every citizen has the right to be appropriately

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informed about the foods they consume. Whilst the provision of food information is regulated in the EU, to ensure a high level of health protection for consumers and to guarantee the right to such information, little is known about the accessibility of food information for consumers with a visual impairment. We, therefore, aimed to explore how consumers with such an impairment experience their access to food information by conducting a phenomenological qualitative study. The phenomenon of access to food information was studied via qualitative, semi-structured interviews with 10 Dutch consumers (above 18 years old) who are partially sighted or blind. Through reflexive thematic analysis, themes were constructed from these interviews. Participants highlighted that they did try to derive food information from labels. Often, they used websites, apps, or other assistive technologies in retrieving such information. Respondents highly differed in their information needs. Whilst the accessibility was mostly not considered to be very good, in line with the variation in needs and wants, interviewees also differed in how important they deemed this food information and its accessibility. The interviews highlighted the need to consider personal interests, health status, and the full buying and cooking procedure in analysing food information needs. Our exploratory study shows that consumers with a visual impairment often face difficulties when attempting to derive food information. Having a visual impairment does not only affect buying and cooking behaviour but has also been previously linked to decreased dietary variety. Limited access to food information may play a role in this. Our study highlights that for people with a visual impairment, deriving information from food labels is hard or even impossible, whilst citizens have the right to information to make well-informed decisions regarding their diet. Consumers with a visual impairment are inclined to stick to familiar products and recipes. Considering the global push towards adopting a healthy and more sustainable diet, which includes new products such as alternative protein, it is important to consider the accessibility of food information to the population.

Keywords: food information; visual impairment; European food law; dietary decisions; qualitative research

Author Contributions: Conceptualization, A.d.B.; investigation, A.S.; formal analysis A.S. and A.d.B.; writing—original draft A.d.B.; writing—review and editing, A.d.B. and A.S.; supervision, A.d.B. All authors have read and agreed to the published version of the manuscript.

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Associations between Eating Behavior and Dietary Intake in a Sample of Type 2 Diabetes Patients [†]

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Abstract: Type 2 diabetes mellitus (T2DM) is a multifactorial chronic condition which is profoundly influenced by dietary interventions. Unfortunately, these interventions often fail to produce the expected results due to the multiple determinants of food choice, with eating behavior having a large contribution. The aim of this study was to evaluate how eating behavior affects dietary intake in a population of patients with T2DM using validated tools. We conducted a cross-sectional quantitative study on a sample of patients with T2DM, assessing dietary intake using the validated EPIC food frequency questionnaire and evaluating eating behavior using the previously validated Dutch Eating Behavior Questionnaire (DEBQ). We used statistical analysis to generate correlations between the three variants of eating behavior obtained from the DEBQ (emotional, external and restrained eating) and dietary intake. In the study population of 416 diabetes patients, the average age was 62.64 ± 9.93 years, and 43.3% ($n = 180$) were men. Emotional eaters and external eaters showed a significantly higher intake of calories, lipids, nonalcoholic beverages (in women) and alcohol (in men). There were no correlations between restrained eating and dietary intake. Healthy eating is an important therapeutic intervention in T2DM, and our data suggest that understanding eating behavior could facilitate more individualized nutritional recommendations, but further studies are required.

Keywords: eating behavior; type 2 diabetes; dietary intake; FFQ



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Relationships between Childhood Food Experiences and the Use of Food Restrictions in Young Adulthood—A Cross-Sectional Study [†]

Marzena Jezewska-Zychowicz ^{*} and Aleksandra Małachowska



Citation: Jezewska-Zychowicz, M.; Małachowska, A. Relationships between Childhood Food Experiences and the Use of Food Restrictions in Young Adulthood—A Cross-Sectional Study. *Proceedings* **2023**, *91*, 164. <https://doi.org/10.3390/proceedings2023091164>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Parental feeding practices are a source of childhood food experiences

(CFE), which can influence behavior in youth and later in adulthood. This study aimed to assess the relationship between CFE related to restrictions, restrained eating, and restricting selected food intake in adulthood. A total of 435 young adults participated in this cross-sectional study carried out in 2020–2021. The questionnaire included questions on feeding practices related to restrictions, restrained eating from the Polish version of the Dutch Eating Behaviour Questionnaire (scales from 1—never to 5—very often), and restricting the intake of sugar and highly processed, high-fat, and high-sugar products (yes/no). Scores for “Restriction for health” (four statements), “Restriction for weight” (eight statements), and “Restrained eating” (nine statements) were calculated by summing the individual scores and counting the mean value. The degree of fit of the scales was satisfactory (Cronbach’s alpha: 0.709, 0.833, and 0.899, respectively). Descriptive statistics and Pearson correlation coefficient ($p < 0.01$) were used in the statistical analysis. The score for “Restriction for health” was 2.8 (mean value), for “Restriction for weight”, it was 1.9, and for “Restrained eating”, it was 2.5. CFE related to the use of restrictions (for health and weight) were positively interrelated ($r = 0.508$). A relationship between experiences of “Restriction for weight” and restrained eating in adulthood was found ($r = 0.294$). About one-fifth of people (22.5%) did not restrict their food intake. Most people limited their sugar intake (57.7%), followed by high-sugar products (44.6%), highly processed foods (38.9%), and high-fat products (37.0%). Adults who restricted food scored higher on “Restriction for weight” (2.0 vs. 1.7) and “Restrained eating” (2.8 vs. 1.8) compared to non-restricting ones. Restrained eating and only CFE of “Restriction for weight” correlated with the restricted consumption of highly processed foods (0.300; 0.118, respectively), sugar (0.380; 0.171), high-sugar foods (0.338; 0.144), and high-fat foods (0.463; 0.161). Experiencing restrictions for weight control in childhood correlates with restrained eating in adulthood. Restrained eating in adulthood is a stronger predictor of restricting sugar and high-fat and sugar-rich foods, as well as highly processed foods, than CFE among young adults.

Keywords: food restrictions; restrained eating; young adults; childhood food experiences

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Estimating Dietary Micronutrient Supply by Analyzing a Moderate-Cost Food Basket in Serbia [†]

Vanja Todorovic *, Nevena Dabetic, Nikoleta Dubovac, Marina Jordanovic, Milica Zrnica Ciric and Sladjana Sobajic



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Abstract: The inadequate intake of essential micronutrients remains a huge public health issue that carries significant social, economic, and health consequences. Although deficiencies in iron, vitamin A, and iodine are well-documented, there is growing recognition of deficiencies in folate, vitamin B12, zinc, calcium, and other micronutrients among disadvantaged populations. A national shopping basket (also known as a food basket or food basket survey) is a list of foods and beverages that represent the typical dietary requirements of a population in a given country. The items in the food basket are chosen based on their frequency of consumption, nutritional value, and availability in the market. This study was designed to assess the intake of certain micronutrients using the food items of a moderate-cost shopping basket in Serbia. The structure of a moderate-cost shopping basket for a family of three in Serbia is published on a monthly basis by the Ministry of Trade, Tourism and Telecommunications. The food list includes 73 food items categorized into nine groups, such as cereals, vegetables, fruits, meats, fish, fats and oils, dairy products, non-alcoholic beverages, and miscellaneous other foods. The food composition database CapNUTRA was used for the calculation of the iron, vitamin A, iodine, folate, and zinc content in all food items in the basket. The monthly quantities, intended for a family of three, of each food item were characterized by their micronutrient contents and the values were summed to derive an estimate of the average intake. When comparing the obtained estimates with the recommended daily intakes, it was noticed that the requirements were met for iron and zinc, but, when it came to vitamin A, the intake was around 20% lower than the recommended value. The iodine and folate intake would be higher than is recommended in the Serbian population, based on such an assessment. The evaluation of nutrient intake using a national shopping basket is one way to estimate the adequacy of a population's diet and essential nutrient supply. However, it is important to note that this approach has some limitations and may not capture the full complexity of an individual's dietary intake.

Keywords: food composition; iron; vitamin A; iodine; shopping basket

Author Contributions: Conceptualization, V.T. and S.S.; methodology, N.D. (Nikoleta Dubovac) and M.J.; software, N.D. (Nikoleta Dubovac) and M.J.; validation, V.T. and N.D. (Nevena Dabetic); formal analysis, V.T. and M.Z.C.; investigation, N.D. (Nikoleta Dubovac) and M.J.; writing—original draft preparation, V.T.; writing—review and editing, V.T. and N.D. (Nevena Dabetic); visualization, M.Z.C.; supervision, V.T. and S.S. All authors have read and agreed to the published version of the manuscript.

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Why Young Adults (18–30 Years Old) Consume Dairy Foods: A Qualitative Study to Explore and Identify Reasons for Dairy Consumption in the UK and France [†]

Caterina Franzon ^{1,2,*} , Anestis Dougkas ², Juliet Memery ³ and Katherine M. Appleton ¹



Citation: Franzon, C.; Dougkas, A.; Memery, J.; Appleton, K.M. Why Young Adults (18–30 Years Old)

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Abstract: Several studies have shown that consuming dairy products may have a positive impact on reducing the risk of obesity, cardiovascular diseases, and helping maintain gut health, while the production of soft dairy, i.e., milk, yoghurt, and soft cheese, has been linked to lower impacts on the environment than meat. Reports show that, despite its benefits, dairy consumption around the world is lower than recommended, decreasing drastically when young individuals leave school. This study aimed to identify reasons for the consumption of dairy foods among young adults aged

18–30 years old in the UK and France and explore the potential differences and similarities between the two countries. Focus groups and individual interviews were conducted in the country's language, audio-recorded, and transcribed. Participants were asked about their reasons for consumption of a wide range of products, e.g., milk, fermented dairy, dairy desserts, cheeses, plant-based dairy alternatives. A thematic analysis was performed. The transcripts were coded; themes and subthemes were generated from codes using an inductive approach. Forty-five young adults (UK = 22) took part in this study; four focus groups and seven individual interviews were conducted in both Bournemouth, UK, and Ecully, France. Four themes (product-related, individual-related, culture, and market offering) and sixteen sub-themes (sensory, non-sensory, composition; mode of consumption, preferences, personal reasons, knowledge, attitudes and concerns, needs or cravings; use, product categorization, social norms; alternative, packaging, value for money, availability) were found to influence participants' dairy consumption in both countries. A seventeenth sub-theme (structure of the meal) was reported only by French participants. The results of this study suggest there are no big differences in reasons for consumption between the UK and France, but due to the limited sample size, further investigations are needed. An online questionnaire was developed from the results of this study and launched in early 2023, aiming to explore reasons, contexts, and modes of consumption of dairy products among a larger sample of young adults in both the UK and France.

Keywords: dairy; reasons for consumption; UK; France; young adults

Author Contributions: Conceptualization, K.M.A. and C.F.; methodology, K.M.A. and C.F.; investigation, C.F.; analysis, C.F. and K.M.A.; writing—original draft preparation, C.F.; writing—review and editing, K.M.A., A.D., J.M. and C.F.; supervision, K.M.A., A.D. and J.M.; funding acquisition, K.M.A., A.D. and J.M. All authors have read and agreed to the published version of the manuscript.

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Validation and Comparison of DEBQ and TEMS in Assessing Eating Behaviours in the Romanian Adult Population [†]

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Abstract: Non-communicable diseases are a major health burden worldwide, and they all share diet as common risk factor. In this context, understanding the complexity of eating behaviours can be useful both at the individual and population level for prevention and treatment. Foremost, there is a need for reliable and simple tools to assess eating behaviours, both for public health research and clinical practice. The aim of this study was to validate in Romanian and test by comparison two internationally popular questionnaires of eating behaviour: The Dutch Eating Behavior Questionnaire (DEBQ), which assesses emotional, external and restricted eating styles, and The Eating Motivation Survey (TEMS), short form, which investigates 15 determinants of food intake (taste, habits, need and hunger, health, convenience, pleasure, tradition, considerations related to the origin of food, social, price, appearance, weight control, social norms and social image). **Methods:** We tested (with the consent of the authors of the original questionnaires) the psychometric properties of the Romanian versions of DEBQ and TEMS on an adult general population and explored associations of eating behaviour with weight status with both questionnaires. Our study showed factor loads similar to the original version of the questionnaire for DEBQ and a very good internal validity (Cronbach’s alpha fidelity coefficient greater than 0.8) for both DEBQ and TEMS. Emotional eating in DEBQ and items related to emotional eating in TEMS showed the strongest correlation with weight, but for all scales of DEBQ, there were further information given by TEMS. This study enables the use of the DEBQ and TEMS in Romania for the adult population. We also consider that the two questionnaires could be used together for developing more adequate strategies to reduce the burden of nutrition-related diseases.

Keywords: eating behaviours; DEBQ; TEMS; food motives; questionnaire validation



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Assessing Awareness on the Role of Diet in Colorectal Cancer Prevention: A Pilot Study [†]

Thea Schembri * and Petra Jones



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Abstract: Colorectal cancer (CRC) incidence can be reduced

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through various modifiable lifestyle factors, including diet and physical activity. Awareness of the risk factors for CRC can encourage individuals to follow cancer prevention recommendations and reduce their risk of developing the disease. The aim of this study was to assess the awareness of the role of diet in CRC development in Malta. The researcher specifically designed a questionnaire that was used to assess knowledge of CRC risk and awareness of dietary factors that affect CRC development. This research tool was validated through a pilot study and ethically approved. Convenience sampling was used to recruit Maltese adults from eight different public places around Malta over a period of three months. The questionnaires were distributed by the researcher, and participants filled in the questionnaire in the presence of the researcher. Data were analyzed statistically using the Chi-squared test, the Kruskal–Wallis test, and the Spearman correlation coefficient. Sample participants (n = 150) were mostly female, well-educated, and employed. Less than half (44%) of the participants were aware that CRC risk can be reduced, but when asked about the link between diet and CRC, 83% of the participants acknowledged that diet affects CRC risk. However, there was poor awareness of how specific dietary factors, including alcohol, calcium supplements, dairy products, processed meat, and fiber, may affect CRC risk. Participants performed better in closed-ended questions than in open-ended ones. They also performed well in questions that asked about sources of fiber, whole grains, and processed meat, although 47.3% of participants failed to recognize bacon as processed meat. Participants were aware that diet affects CRC development, but awareness of the association with specific food groups and nutrients was poor. Public health strategies should be targeted towards raising awareness of cancer prevention recommendations, especially in younger generations. Despite its limited sample size, this pilot study is the first to investigate awareness of this association in Malta, thus paving the way for a study looking at a representative sample of the Maltese population.

Keywords: colorectal cancer; awareness; diet; Malta

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Data Availability Statement: The data presented in this study is available in Open Access Repository University of Malta (OAR@UM) at <https://www.um.edu.mt/library/oar/handle/123456789/67779> (accessed on 31 January 2024).

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Cooking Workshop for Preventing Malnutrition in the Elderly: Participants' Social Roles, Expectations and Related Effects on Food Habits [†]

(https://

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: French public fundings allow NGOs to organise actions (cooking workshops including a dietician and a cooking chef) among elderly people to prevent malnutrition and loss of autonomy. Although similar interventions have already been evaluated in terms of change in knowledge and food habits, little is known about how the social roles and expectations of the participants impact the effects of the actions implemented. Methods: Following their participation in cooking workshops, 42 semi-structured interviews with various participants, including elderly people aged 60 and older, were conducted in five French regions. For 24 participants, a second interview was conducted 2–3 months later. The interviews aimed to understand their representations and practices towards health, cooking and eating, social position, life events, expectations and the effects of their participation in the cooking workshops. Results: The social roles of the participants were overall strongly linked to the effects of participation. The feeding role and domestic work of the female participants lead them to look for new recipes when participating in such workshops and to use the recipes afterwards. For some participants who cook on a daily basis, expectations were also related to reinforcing dietetic knowledge, to check whether it was up-to-date and if they were sometimes looking for moral validation of their behaviour from the dietician. These participants, who had the ability to adapt their cooking practices according to the dietetic advice provided, were all from a higher social position. Others, men and women, who had recently experienced an illness and/or hospitalisation, expected to hear some advice they had previously received. The minority of participants, mostly men, declared not knowing how to cook and saw an interest in learning this skill at some determining point in their life cycle. Finally, the decision of participating in such workshops meets the need of being part of a group, to feel less lonely and a sense of well-being that resulted from this group experience. Discussion: By highlighting three dominant approaches of the participants (cooking/dietetic knowledge/being part of a collective activity), depending on their social roles at some point in their lifecourse, these results can help in refining the design and intensifying the effects of preventive actions in the elderly.



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Place of Residence Is Associated with Dietary Intake and BMI-SDS in Children and Adolescents: Findings from the DONALD Cohort Study [†]

Janosch Klemm ^{1,*}, Ines Perrar ², Christian Borgemeister ¹, Ute Alexy ² and Ute Nöthlings ²



Citation: Klemm, J.; Perrar, I.; Borgemeister, C.; Alexy, U.; Nöthlings, U. Place of Residence Is Associated with Dietary Intake and BMI-SDS in Children and Adolescents: Findings from the DONALD Cohort Study. *Proceedings* **2023**, *91*, 40. <https://doi.org/10.3390/proceedings2023091040>

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Abstract: Background and objectives: To determine whether location of residence in the German urban food environment is associated with habitual dietary intake (energy, macronutrient and food groups) and body mass index (standard deviation score of BMI, BMI-SDS) in children and adolescents (6–18 years). Methods: For the cross-sectional analyses of DONALD study data, we grouped participants according to their geocoded residence in the north or south of Dortmund, following available socio-economic neighborhood indices. We applied robust multi-level mixed effects regression models using residence as predictor and (1) BMI-SDS or (2) dietary data (daily intake of energy (kcal), macronutrients (energy percentage) or food groups (g/1000 kcal)) as outcome. Analysis was carried out on 935 3-day weighed dietary records, collected annually from 292 participants (1267 anthropometric measurements from 360 participants) between 2014 and 2019. Models were adjusted for age, sex and household socioeconomic status (SES, derived from household education and occupation data). Results: We observed that 52 (14.4 %) participants reside in the north and 308 (85.6 %) in the south of Dortmund. In the fully adjusted models, residence in the south was associated with lower BMI-SDS ($\beta = -0.42$, $p = 0.02$), lower intake of sugar-sweetened beverages ($\beta = -48.24$, $p = 0.04$) and higher intake of vegetables ($\beta = 11.69$, $p = 0.03$). No significant association was found for intakes of macronutrients or other food groups (meat and fish, fruit, dairy, grains, sweets). Discussion: Our results suggest that place of residence may play a role in explaining variation in dietary intake, beyond the SES of the household. This indicates that dietary intake may at least in part be impacted by factors beyond individual-level indicators. Further research is required to identify more specific pathways of location of residence on nutrition and quantify the food environment in different city areas across socio-economic background variables.

Keywords: dietary intake; children; adolescents; urban settings; spatial trends

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Advancing Food Consumer Science to Facilitate Health and Sustainability Transitions: Bridging Complexity, Collaboration, and Ensuring FAIR Data [†]

Ellen van Kleef ^{1,*}, Machiel Reinders ¹, Elena Horská ², Barbara Koroušič Seljak ³, Liisa Lähteenmäki ⁴, Lada Timotijevic ⁵ and Hans van Trijp ¹



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Abstract: The nutritional quality of our diet depends on a number of repeated choices we make throughout the day. Understanding consumer behaviour in its full complexity and real-life context is essential for ensuring a sustainable food system that provides nutritious diets to nearly 10 billion people by 2050. Food consumer science, a multidisciplinary field, aims to comprehend how consumers engage with, desire, obtain, utilise, and dispose of food to meet their physiological, psychological, and social needs. However, the field's fragmented nature and narrow focus on isolated product choices have hindered progress in understanding food consumption patterns and their relationships to lifestyles. To address these challenges, fostering greater connectivity and collaboration among scientists from diverse disciplines and regions is crucial. This presentation explores data proliferation and system thinking's potential for significant advancements in the field. While the incorporation of technologies like neuroimaging, physiological measures, virtual reality, and machine learning holds promise, the complexity of the field and the lack of integration present legitimate concerns and obstacles. This presentation highlights food consumer science's indispensable role in health and sustainability transitions, emphasising the importance of ensuring that the data we produce are Findable, Accessible, Interoperable, and Reusable (FAIR). It showcases approaches to improve data sharing in consumer science, demonstrating progress in harmonising measures, ensuring crosscultural comparability, and addressing biases in data collection and analysis. Furthermore, we explore the opportunities and challenges associated with establishing research infrastructure in food consumer science, specifically highlighting the EU Horizon 2020-project COMFOCUS as a starting point.

Keywords: research infrastructure; food consumer science; FAIR data; consumer behaviour

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Orthorexia Nervosa in UK Cyclists: Associations with Excessive Exercise and Perfectionism [†]

Kyriaki Myrissa * , Catriona MacIntosh and Eirini Kelaiditi



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Research about exercise addiction, perfectionism and orthorexia within endurance sports is emerging. Endurance sports athletes might have a higher risk of exercise addiction and eating disorders. Cycling is a popular endurance sport, but research in this population is lacking. The present study aimed to explore the relationship between exercise addiction, perfectionism, and orthorexia within cycling. Methods: A cross-sectional survey was applied, including validated questionnaires assessing the cognitions, behaviors, and feelings related to an extreme focus on healthy eating (Eating Habits Questionnaire; EHQ), compulsion to exercise (CET-A Questionnaire), and perfectionistic tendencies (Multidimensional Perfectionism Questionnaire). Demographic information such as age, training hours, gender, and competition level were also collected. Results: Sixty-one male ($n = 5$; 8.2%) and female (54; 88.5%) cyclists with a mean age of 32 ± 7 years completed the survey. Higher scores in orthorexia were significantly associated with higher exercise addiction ($\beta = 0.41$; $p < 0.001$) and total perfectionism scores ($\beta = 0.38$; $p < 0.01$). Higher orthorexia was also associated with higher scores for self-oriented perfectionism ($\beta = 0.34$, $p < 0.05$) and higher weight control ($\beta = 0.39$, $p < 0.01$). Higher EHQ-Knowledge was associated with higher self-oriented ($\beta = 0.33$, $p < 0.05$) and other-oriented perfectionism ($\beta = 0.30$, $p < 0.05$) and higher EHQ-Problems and EHQ-Feelings were associated with higher weight control ($\beta = 0.39$, $p < 0.01$ and $\beta = 0.41$, $p < 0.01$ respectively). Cyclists who trained 16–20 h per week had significantly lower scores on total perfectionism and socially prescribed perfectionism than those who trained 6–10 h per week ($p < 0.05$). No other significant effects of training hours on exercise addiction or orthorexia were observed. Discussion: The potential risk of an individual developing orthorexia may be significantly predicted by high levels of exercise addiction and perfectionism within the cycling population. The high levels of self-oriented perfectionism observed highlight a potential predisposition or susceptibility within certain populations to the adoption of maladaptive behaviours in relation to diet. Further research is needed to explore the role of perfectionism and exercise addiction as risk factors for orthorexia in amateur and professional cyclists.

Keywords: orthorexia; perfectionism; exercise addiction; cycling

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Higher Ultra-Processed Food (UPF) Intake Is Associated with Poorer Overall Dietary Quality Compared to Lower UPF Intake: Results from a Pilot Study [†]

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Abstract: Background and objectives: Numerous studies link ultra-processed food (UPF) intake to adverse health outcomes. However, data on the relationship between UPF intake and overall dietary quality are scarce. Therefore, the present analysis aimed to explore possible differences in dietary intake between people with a high UPF intake and those with a low one. Methods: A cross-sectional study was conducted between 12/2022 and 4/2023, in which 113 adults (49.56% females, from 18 to 65 years of age) participated. Dietary habits were evaluated in terms of energy, macronutrients, food variety, and UPF intake using 24 h recalls. Food classification as UPFs was based on their processing using the NOVA system. Self-reported demographic and anthropometric characteristics of the participants were also noted. For the present analysis, participants were grouped into those with a lower (LUPFI) and those with a higher UPF intake (HUPFI), using the median (Mdn) value as a cut-off. Differences between groups were examined, using the chi-square test for qualitative variables, and the independent samples t and Mann–Whitney tests for quantitative parametric and non-parametric variables, respectively. The level of statistical significance was set at 5%. Results: The two groups did not statistically significantly differ in age ($p = 0.649$) and BMI ($p = 0.252$). Regarding dietary intake, the LUPFI group consumed less energy (Mdn 1686 vs. 2117 kcal, $p = 0.009$), more protein (18.1 ± 4.2 vs. $15.7 \pm 3.9\%$, $p < 0.001$), fewer carbohydrates from UPF (11.3 ± 6.9 vs. $26.3 \pm 10.0\%$, $p < 0.001$), less fat from UPFs (Mdn 6.4 vs. 24.2%, $p < 0.001$), more food variety (Mdn 11.0 vs. 9.0 foods, $p = 0.009$), less variety of UPFs (Mdn 3.0 vs. 4.0 foods, $p < 0.001$), less total and UPF sweet desserts (Mdn 0.0 vs. 1.0, $p = 0.022$ and $p = 0.033$, respectively), and less UPF cheese (Mdn 0.0 vs. 0.5, $p < 0.001$). Discussion: These preliminary results show that higher UPF consumption is associated with a higher energy intake and poorer diet quality, although it does not necessarily translate into worse choices across all food groups. Further research is needed to verify the present findings and to explore the relationship between UPFs and overall dietary intake more thoroughly, as well as to identify those UPFs that actually contribute to a poorer dietary quality.

Keywords: ultra-processed foods; NOVA system; dietary quality; food groups



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Association between Mindful Eating and Food Consumption in the NutriNet-Santé Cohort Study [†]

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Abstract: Background and objectives: Mindful eating (ME) is defined as non-judgmental awareness of the physical and emotional sensations experienced while eating. An association between ME and healthier eating behaviors has been suggested. However, there are only few observational studies available. The aim of this cross-sectional study was to investigate the association between ME levels and food consumption, in particular, diet quality, food groups, and ultra-processed food consumption, in a general population sample. Methods: In 2022, 2069 participants of the NutriNet-Santé Study completed the Mind-Eat scale, a validated questionnaire assessing ME as a whole and its six dimensions. Participants also completed at least three 24 h dietary records. Adherence to the French dietary guidelines was assessed via the French National Nutrition and Health Program Guideline Score (PNNS-GS2). The degree of food processing was assessed using the NOVA classification. Logistic and linear regressions were used to analyze associations between ME as the exposure (score from 1 to 5), and diet quality, food groups, and ultra-processed food consumption as outcomes, stratified by sex, and considering sociodemographic and lifestyle covariates. Results: Men and women with a higher ME score showed better adherence to dietary guidelines (men: $\beta = 1.05$, 95%CI: 0.53, 1.58; women: $\beta = 0.74$, 95%CI: 0.40, 1.09), and a lower consumption of ultraprocessed food (men: $\beta = -0.02$, 95%CI: -0.04 , -0.01 ; women: $\beta = -0.02$, 95%CI: -0.03 , -0.01). They also consumed fewer dairy products and meat, and more non-salted oleaginous foods. In addition, women with higher levels of ME consumed more fats and eggs, and fewer processed meat and chocolate based-products, while men consumed more vegetables, whole-grain products, and starches, and less seafood. Regarding macronutrients, individuals with higher levels of ME consumed less protein overall and animal protein, but more plant-based protein. In addition, women with higher ME levels consumed more added fats and omega 3, and less total energy and simple and added carbohydrates, while men consumed more fibers and plant-based lipids. Discussion: ME was associated with a healthier overall diet. These findings suggest that ME could be helpful in the promotion of healthy eating behaviors. Further studies on the dimensions of ME are needed.

Keywords: nutrition; food intake; mindful eating; psychology; cross-sectional study

Author Contributions: Conceptualization, P.P.-G. and S.P.; methodology, P.P.-G. and S.P.; software, P.P.-G.; validation, M.V.B., R.S., A.R., E.K.-G., M.T. and S.P.; formal analysis, P.P.-G.; writing—original draft preparation, P.P.-G.; supervision, S.P. All authors have read and agreed to the published version of the manuscript.

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Can Eating Behaviour Traits Be Explained by Underlying, Latent Factors? An Exploratory and Confirmatory Factor Analysis [†]

Clarissa Dakin ^{*}, R. James Stubbs [†] and Graham Finlayson [†]



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Abstract: Eating Behaviour Traits (EBTs) are psychological constructs developed to explain patterns of eating behaviour, including factors that motivate

people to (over or under) eat. There is a need to align and clarify their unique contributions and harmonise the understanding they offer for human eating behaviour. Therefore, the current study examined whether 18 commonly cited EBTs could be explained by underlying, latent factors (domains of eating behaviour). An exploratory factor analysis (EFA) was used to identify latent factors, and these factors were validated using a confirmatory factor analysis (CFA). A total of 1279 participants including the general public and members of a weight management programme were included in the analysis (957 females, 317 males, 3 others, 2 prefer not to say), with a mean age of 54 years (median = 57 years, SD = 12.03) and a mean BMI of 31.93 kg/m² (median = 30.86, SD = 6.00). The participants completed 8 questionnaires which included 18 commonly cited EBTs and the dataset was split at random with a 70/30 ratio to conduct the EFA (*n* = 893) and CFA (*n* = 383). The results supported a four-factor model which indicated that EBTs can be organised into four domains: reactive, restricted, emotional, and homeostatic eating. The four-factor model also significantly predicted self-reported BMI, weight change and perceived stress. Future research should test whether this factor structure is replicated in more diverse populations, and including other EBTs, to advance these domains of eating as a unifying framework for studying individual differences in human eating behaviour.

Keywords: eating behaviour; obesity; reactive eating; restricted eating; homeostatic eating; emotional eating

Author Contributions: C.D. performed the data analysis, interpreted the data, and created the written article. All authors critically revised the manuscript. All authors have read and agreed to the published version of the manuscript.

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Consumer Acceptance and Nutritional Expectations of Microalgae Protein Products: Insights from a Cross-European Study [†]

Yung Hung * , H el ene Van der Stricht and Wim Verbeke 



innovation; super food; single-cell protein; sustainability

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Keywords: algae; alternative protein; attitude; behaviour; clean-label ingredient; consumer trends; food

Alternative proteins, such as microalgae proteins, have the potential to mitigate climate change impacts and foster sustainable development. Microalgae proteins offer several advantages over traditional animal proteins, including comparable nutritional quality, lower environmental footprint, and higher production efficiency. Consumer acceptance is key to the successful development of microalgae proteins and is examined in this study. Within the EU-funded “ProFuture” project (H2020), a large-scale cross-sectional consumer survey was conducted in Germany, Hungary, Italy, Spain, and the Netherlands ($n = 3027$) [1,2]. The study investigated consumers’ willingness to try (WTT) food products with microalgae proteins and the potential determinants related to health, nutrition, sustainability, and product attributes. WTT was measured in general and based on various product types (bread, energy bars, pasta, plant-based sausage, plant-based cream, and soup) and microalgae species (*Chlorella*, *Spirulina*, and *Tetraselmis chui*). Consumers were categorized into three groups: ‘enthusiast’ ($n = 1142$), ‘uncertain’ ($n = 830$), and ‘uninterested’ ($n = 1055$) based on their WTT. Multinomial logistic regression with bootstrapping was used to identify the attitudinal determinants of consumers’ WTT for products with microalgae proteins, with a special focus on the role of nutrition-related expectations (Pseudo $R^2 = 25.1\%$). Generally, consumers were willing to try food products containing microalgae proteins. Key determinants differentiating the three groups included perceived product pleasantness and naturalness, general health interest, sustainability, and animal friendliness for food choice motives. In terms of nutrition-related expectations, perceiving products as rich in vitamins, minerals, and protein increased the likelihood of being an ‘enthusiast’ rather than ‘uninterested’; the perception of products as high in fiber decreased the likelihood of being ‘uncertain’ compared to ‘uninterested’. Comparing the nutritional profiles of ProFuture microalgae products with similar market products yielded insufficient evidence to conclude that microalgae products offer better nutritional profiles. Therefore, marketing messages for microalgae protein products should address environmental benefits rather than nutritional quality. Product reformulation and marketing communication to improve both perceived and actual nutritional profiles could enhance consumer WTT and eventually drive the market success of alternative proteins.

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Adherence to the Mediterranean Diet and Its Association with Sustainable Dietary Behaviors, Sociodemographic Factors, and Lifestyle: An Online Survey in Italian and US University Students [†]

Cinzia Franchini ^{*} , Beatrice  Biasini , Giovanni Sogari , Rungsaran Wongprawmas , Giulia Andreani , Francesca Scazzina  and Alice Rosi 



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: The declining trend of the adherence to Mediterranean Diet (MD) and shift toward Western-type dietary patterns involve different age groups across the world, including young generations. University students are particularly involved in this process as university life exposes them to the risk of developing unhealthy dietary behaviors and diet-related chronic diseases in later life. In this context, the present cross-sectional study was aimed at investigating the level of adherence to the MD and its association with sociodemographic and anthropometric variables, and lifestyle-related factors, including the adoption of sustainable dietary behaviors, in two national representative samples of university students (18–24 years) living in Italy (IT) and in the United States (US). Methods: The adherence to the MD and sustainability of dietary behaviors were assessed by applying the KIDMED questionnaires and the Sustainable-HEalthy-Diet (SHED) Index, respectively. Both instruments provide a total score. In addition, the SHED Index includes six sub-scores (i.e., Healthy Eating, Sustainable Eating, Place of Purchase of Fruits and Vegetables, Prepared Meals, Water, and Soda). Results: The final samples consisted of 1434 and 1485 Italian and American students, respectively. Most of the participants had an average adherence to the MD (IT: 55%; US: 47%). In both populations, meeting physical activity recommendations, having a high SHED Index score, mainly consuming plant-based foods, being prone to purchase and eat healthy and sustainable dishes, and regularly attending the university canteen were the most powerful predictors of having a high adherence to the MD. Discussion: In this connection, a major promotion of the MD as a sustainable dietary pattern may be an effective strategy for its revitalization. Considering the positive influence that university canteen attendance has on students' eating habits, campuses and university dining services represent a unique opportunity to build a supportive environment that educates students about the effects of their actions and fosters human and planetary health.

Keywords: Mediterranean Diet; sustainable diet; healthy eating; food-related behavior; young adults

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data collection tools used, and dataset generated during the present study may be made available by the corresponding author on reasonable request.

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How Can Older Consumers Become More Conscious of an Optimal Protein Intake—Outcomes of the ConsuBETER Study[†]

Joost O. Linschooten^{1,*}, Marije H. Verwijs², Marian A. E. de van der Schueren^{3,4} and Annet J. C. Roodenburg¹



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Keywords: older adults; protein intake; health consciousness

The number of people that are 65 years and older living at home in the Netherlands is increasing. A healthy diet with sufficient protein supports their health and vitality. Our aim was to make older adults more aware of the importance of an optimal protein intake and to gain insight in how to support them in making the right choices. In this 2-year project, several studies were carried out to characterise the needs and preferences of the population, to calculate potential food intake scenarios, and to determine the influence of behaviour on protein intake. Qualitative studies with interviews show that many older adults do not want to change their current dietary behaviour and are unaware of the need for a higher protein intake. The participants underestimated the important role of dietitians. However, they were unable to properly estimate their current daily protein intake [1]. Different protein intake scenarios were calculated using the Dutch food consumption survey, in which regular food products were replaced by products (1) with a higher natural protein content, (2) enriched with protein, or (3) a combination of protein-rich and protein-enriched products. This theoretical approach showed that it is possible to increase protein intake (>1.0 g/kg bw/day) without a significant increase in the amount of food consumed [2]. We also studied different aspects of behaviour which influence the protein intake of older adults living at home. A total of 824 Dutch older adults living at home completed an online questionnaire on the influence of behavioural factors on dietary behaviour. Behaviour was characterized by the IChange model [3], and dietary behaviour was expressed as a risk on low protein intake, as determined by the Protein Screener55+ [4]. The results show that mainly ‘knowledge’ and ‘social interaction’ were identified as independent determinants of elderly dietary behaviour [5]. Altogether, these data show the importance of dietary behaviour aspects such as knowledge and social interaction to optimise protein intake. They also show the opportunities to further improve protein intake. Our next question would be how to conduct this study in a sustainable way.

Author Contributions: J.O.L. presented the abstract. J.O.L., M.H.V., M.A.E.d.v.d.S. and A.J.C.R. wrote the abstract and analysed the data. All authors collaborated in the project and were involved in funding acquisition. All authors have read and agreed to the published version of the manuscript.

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The consortium behind the present study involves several universities (of applied sciences), research institutes and food companies. The funders had no role in the design of the study; in the collection, analyses, interpretation of data, or in the decision to publish the results.

Institutional Review Board Statement: Ethical and legal advice was obtained from the HAN University of Applied Sciences, Nijmegen, The Netherlands. It was judged not to fall within the remit of the Medical

Research Involving Human Subjects Act (WMO) and ethical clearance was provided by the review board.

The study was conducted in accordance with the Declaration of Helsinki. All participants were informed to consult their general practitioner and/or a dietician in case of a high chance of a low protein intake and received a flyer from the Dutch Malnutrition Steering Group with additional information.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Anonymized data can be made available upon request from the corresponding author. Due to privacy and ethical restrictions, data are not publicly available.

Conflicts of Interest: The authors declare no conflict of interest.

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War-Induced Disrupted Eating Behaviors in Ukrainian School-Aged Children [†]

Mariia Gulich ^{1,*} , Dina Fedorova ² , Olena Petrenko ¹, Henna Vepsäläinen ³  and Maijaliisa Erkkola ³ 



Citation: Gulich, M.; Fedorova, D.; Petrenko, O.; Vepsäläinen, H.; Erkkola, M. War-Induced Disrupted Eating Behaviors in Ukrainian School-Aged Children. *Proceedings* **2023**, *91*, 77. <https://doi.org/10.3390/proceedings2023091077>

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Abstract: Background and objectives: Russian military aggression in Ukraine has exposed children to extremely high levels of acute and chronic stressors that are incomparable to stress levels in peaceful countries. Such stressors can impact children’s eating behavior, for example, by altering the psychological climate within families. We aimed to determine the prevalence of war-induced, stress-related disruptions in the eating behavior of Ukrainian children. Methods: We used a cross-sectional survey to determine stress-related disordered eating behavior among school-aged children under conditions of stress caused by the war in Ukraine. A total of 5162 parents or guardians used an electronic questionnaire to report changes in the children’s eating behavior (EB) in various stressful conditions, including being in close proximity to the combat zone, residing in occupied or peaceful territories, displacement from homes, abroad, and other. 311 (6%) of participants did not report the age of the child or reported on behalf of a child who was younger than 5 years or older than 17 years, and were thus excluded. Thus, the final sample included 4854 (94%) parents. Results: of the guardians, 63% reported changes in children’s EBs during the war, with the highest frequency observed among 5 to 10-year-olds. The most common EB changes observed during wartime included food cravings (38%), food fussiness (37%), aversion to certain foods (29%), and decreased appetite (24%). 40% of the

reported EB changes were long-term, lasting over a month and related to altered attitudes towards food. Food insecurity, residing in occupied territories, and displacement emerged as the most influential determinants of EB changes. Discussion: The findings underscore a significant and robust association between various war-related exposures and an increased risk of frequent eating behavior changes. As healthy eating behaviors are learned during childhood and have been shown to track into adulthood, the

identified disruptions in eating behavior may have significant long-term consequences for the physical and mental health of the Ukrainian children. More research is needed to determine whether the intensity of the identified changes in children's eating habits is linked to the severity of the stressors.

Keywords: eating behaviors; war-exposure; school-aged children

Author Contributions: M.G. and O.P. conceptualization and project administration; M.G., D.F. and O.P. data curation, methodology and original draft preparation; H.V. and M.E. supervision; D.F., H.V. and M.E. funding acquisition. All authors provided critical revisions. All authors have read and agreed to the published version of the manuscript.

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Preliminary Findings Regarding Nutrition Information Needs among Family Physicians in Turkey [†]

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Abstract: Background and objectives: Considering the information pollution in the field of nutrition and health in society, more than half of the community asks family physicians (FPs) as the closest counseling unit about healthy nutrition and related issues. However, FPs' nutritional knowledge levels are limited, and nutrition-related courses are not an integral part of their education. There is a need to organize postgraduate nutrition-based training programs for FPs. Methods: In order to determine the training needs of FPs, a needs assessment questionnaire was developed by the researchers in order to select topics in which they need to be trained before preparing a training program. There were 26.252 FPs in Turkey at the time of the study. AHEF is the federation of all seventy-six FP associations in Turkey. FPs who are members of any of these associations constituted the study population. The questionnaire was sent to all registered FPs electronically. Results: The questionnaire was replied to by 1308 FPs, of whom 46% were female and the average working period was 15 ± 3 years (1–38). Only 26.4% of the FPs declared that they felt competent while answering patients' questions on nutrition, 12.8% thought their knowledge was insufficient, 62.6% thought their knowledge was partly sufficient, and 23.2% recommend some kind of supplement to their patients. The topics that are indicated by the FPs were quantified and taken into consideration while the training program was prepared. The training program, which provided the first ever nutrition and nutrition communication online information platform for physicians in Turkey, was developed in collaboration with an NGO, the university, and AHEF. It consisted of eight online training topics starting in March 2022 and was conducted once every two weeks. Discussion: Postgraduate nutrition training programs for physicians and other health professionals who wish to improve their current knowledge of the role of nutrition and communication in the prevention and management of chronic diseases are limited worldwide. It is necessary to increase the level of nutrition knowledge of FPs with postgraduate training programs. Nutrition communication is the next step toward improvement.

Keywords: nutrition; family physician; nutrition communication



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Parents and Social Media: Nutritional Education Is Online! [†]

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Abstract: Poor eating habits have been correlated with an increased probability of developing chronic health problems, including weight gain. In particular, dietary choices during the first years of life can have a lasting impact on dietary preferences and habits. Parents strongly influence the child's relationship with food which will be maintained for the rest of their life; in particular, a greater sense of maternal self-efficacy is correlated with healthier eating habits and the child being less overweight. To date, there are few studies investigating the relationship between parental eating habits, self-efficacy in promoting healthy behaviors and the use of social media (SM). The general purpose of our study is to investigate the eating habits of families, food awareness and choices and the use of SM to search for pediatric nutrition content. The habits were collected through a questionnaire administered online on the most popular SM platforms. Data show that parents take care of their children's food choices (96.1%) and rarely comply with their requests (77.9%). More than half read

product labels (56.1%) and the origin (43.9%) before purchasing. Overall, 44.1% are influenced by TV and newspapers regarding their purchases, while 39.4% are influenced by the opinions of their friends and relatives. Food style correlates positively with the influence of TV and newspapers ($r = 0.238$) and the influence of friends and relatives ($r = 0.231$). Overall, 77.1% aim to follow a healthy diet, even if fish (24.5%) and vegetables (36.3%) are difficult to include in the child's diet. Instagram (50.2%) and Facebook (36.3%) are the SM platforms most used to search for information on pediatric nutrition. Health professionals' (60.3%) and institutions' (24.9%) profiles are the most followed for reading articles and blogs (59.4%), but without direct interactions (78.9%). Only 20% are satisfied with the content found. Parental self-efficacy in promoting a healthy diet for their children correlates positively and moderately with encouragement to follow a healthy



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diet ($r = 0.340$) and control over the amount of snacks and sweets consumed ($r = 0.302$). The data demonstrate parents' interest in using SM to search for information on pediatric nutrition but indicates that few (33.3%) are satisfied with what they find online. Therefore, future educational interventions need to be refined to help parents to better influence children's eating habits.

Keywords: nutritional education; social media; pediatric nutrition; food awareness; self-efficacy

Author Contributions: Conceptualization, E.C. and A.G.; methodology, F.B.; software, F.B.; formal analysis, F.B., E.L. and P.C.; investigation, F.O.; data curation, F.B. and A.G; writing—original draft preparation, E.C. and F.B.; writing—review and editing, A.B. All authors have read and agreed to the published version of the manuscript.

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Hands-On Interaction with Food as a Means of Increasing Vegetable Intake in Preschool Children [†]

Aoibhín Moore Heslin ¹ , Hannah Furlong ², Aoife McDunphy ³ and Kirstie McAdoo ^{1,*}



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Preschool years are a highly formative period in a child’s life and present a critical opportunity for the cultivation of enduring healthy eating habits. Trying new vegetables can be a challenge for young children as they can often be wary or even averse to the unfamiliar tastes, textures, smells, sights, and sounds posed by new foods. This study aimed to assess how engaging preschool children in growing food and playing with food influences their vegetable consumption and willingness to try new foods. Intervention studies were conducted with children aged 3–5 years in four Irish preschool classes across three different preschools, with two classes partaking in a vegetable-focused sensory learning intervention ($n = 33$), and two classes being involved in a gardening-based food education intervention ($n = 57$). The sensory learning intervention involved playing with three different foods, tomatoes, peas, and bell peppers, with the children’s consumption of these foods measured at baseline and after partaking in two interactive sensory learning classes. The gardening-based intervention centered around watercress and compared the effects of a hands-on planting activity versus a storytelling control activity on preschool children’s perceptions and reactions to tasting watercress. The sensory learning intervention was successful in encouraging preschool children to eat more vegetables, with children consuming on average 85% more peppers ($p < 0.001$), 24% more peas ($p = 0.002$), and 17% more tomatoes after the intervention. Children showed a greater willingness to try new foods after experiencing sensory learning, with over 50% of those who refused to try peas and peppers at baseline opting to try the vegetables after the intervention ($p < 0.001$). Involvement in the hands-on planting activity resulted in a slightly higher willingness to try what was a new vegetable for 79% of children, with 48% of the children in the planting group opting to taste the watercress compared to 32% in the storytelling group. This research indicates that providing preschool children with the opportunity for hands-on interaction with food aids in increasing their vegetable consumption and can make them more receptive to trying new foods. Use of these techniques can help to cultivate positive early food experiences that can have a lasting impact on lifelong food habits.

Keywords: preschool children; sensory learning; vegetable intake; food preferences; food education; experiential learning; taste exposure; health promotion

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Vitamin D Supplementation Practices in Slovenian Adults in Context of COVID-19 Pandemic [†]

Maša Hribar ^{1,2,*} , Katja Žmitek ^{1,3}  and Igor Pravst ^{1,2,3} 



Keywords: vitamin D; COVID-19; supplementation

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Vitamin D is a critical micronutrient in numerous body functions; it is important in musculoskeletal health and the functioning of the immune system. The prevalence of vitamin D deficiency is alarming worldwide. During winter, around 80% of adults in Slovenia have insufficient serum 25-hydroxy-vitamin D levels (<50 nmol/L) [1]. Low vitamin D status was also investigated as a risk factor in COVID-19, which led to increased media coverage on the significance of supplementation. Consequently, in Slovenia, the prevalence of supplementation rose from 33.7% (pre-pandemic) to 55.6% during the pandemic in December 2020 [2]. Our objective was to investigate changes in supplementation practices after the pandemic. We analysed data collected in three cross-sectional studies examining vitamin D supplementation in the adult population in Slovenia, Europe. The study details for the data collection in April 2020 and December 2020 are described elsewhere [2]; the same method was also used for the reported sampling in January 2023. Participants were recruited from a large consumer panel using quota sampling, resulting in a study sample representative of age, gender, and region. Participants completed the online survey upon invitation. A study in January 2023 was conducted on 800 adult subjects (18–65 years old), of which 57.6% (N = 461) reported supplementation with vitamin D. The median daily dosage of supplemented vitamin D was 25 µg. After COVID-19, the prevalence of supplementation was very comparable, with observations during the winter 2020 wave of the pandemic (57.6%) and notably higher than in the pre-pandemic winter of 2019/2020 (33.7%). No change was observed in the median vitamin D intake among supplement users. The findings of the study emphasized that general public awareness campaigns regarding vitamin D during the COVID-19 pandemic had lasting effects, as individuals continued with vitamin D supplementation during the winter even after the pandemic. However, approx. 40% of the population still remains at risk for deficiency.

Author Contributions: I.P. and K.Ž. conceived the study. I.P., K.Ž. and M.H. designed the study questionnaire. M.H., K.Ž. and I.P. analyzed and interpreted the data. M.H. wrote the first manuscript draft and all authors then made revisions. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The studies involving human participants were reviewed and approved by Bioethical Committee of the VIST—Faculty of Applied Sciences in Ljubljana, Slovenia (VIST ET-6/2020).

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Conflicts of Interest: I.P. and K.Ž. are members of a national workgroup responsible for the development of recommendations for assuring adequate vitamin D status among the Slovenian population. All authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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The Knowledge, Attitudes and Practices of Pharmacy Professionals in the Provision of Nutrition Counselling and Diet-Related Advice [†]

Gizem Acar ^{1,*} , Rachael Frost ², Sukvinder Kaur Bhamra ³  and Michael Heinrich ¹ 



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Unhealthy diets are the number one risk factor for NCD-related morbidity and mortality. Interventions and services to change dietary behaviours and consumption patterns, and to improve health and nutrition literacy through education, are some fields in which health professionals can intervene to improve public health nutrition. Pharmacy professionals are in a unique position to play an integral role in educating people about modifiable behaviours such as dietary practices and healthy lifestyles. As universally accessible and ideally positioned healthcare providers, they can make an important contribution to improving public health nutrition and potentially impact the rising epidemic of obesity and NCDs through specific interventions, services, and education. Following the scoping review that explored the role of pharmacists in improving nutrition and diet-related NCDs, an online survey is being conducted to assess the knowledge, attitudes and practices of pharmacy professionals in the provision of nutrition counselling and diet-related advice in their routine practice. The survey explores the following areas: the nutrition knowledge of pharmacy professionals; nutrition advice in various conditions related to diet, such as weight management, diabetes, cardiovascular diseases, dietary supplements, and micronutrient deficiencies; the provision of nutritional services and the level of importance of providing these services for improving population health and wellbeing; the nutrition topics on which patients ask advice (the frequency of asking) and their perceived level of confidence in giving advice on those topics; the use of national food-based dietary guidelines; their attitudes towards providing nutrition advice and counselling services; exploring their perceived roles and future ambitions; and training needs and further barriers and facilitators to improving nutrition services in the pharmacy setting. The survey is currently in the active data collection stage. Our preliminary findings indicate that the most common nutrition advice offered to patients is on diabetes (70%), followed by cardiovascular disease risk factors (64%), overweight and obesity (53%) and dietary supplementations (47%). Based on qualitative findings, it appears that there is a need for greater recognition of the significance of nutrition in pharmacy practice. Pharmacists expressed interest in training and resources on nutritional management and guidelines, as well as working hand-in-hand with dietitians.

Keywords: nutrition counselling; pharmacy practice; nutrition advice; nutrition care in pharmacy; community pharmacy; nutrition services in pharmacy; pharmacists' knowledge of nutrition; dietary advice

Author Contributions: Conceptualization: G.A., M.H., R.F. and S.K.B.; Methodology: G.A., M.H., R.F. and S.K.B.; Analysis: G.A.; Writing: G.A.; Review and editing: M.H., R.F. and S.K.B.; Supervision: M.H., R.F. and S.K.B.; Project Administration: G.A. and M.H.; Funding acquisition: G.A. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the UCL Research Ethics Committee (ethics ID number: 24591/001).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Only anonymous data presented in this study are available on request from the corresponding author.

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Dietetic Educators’ Perspectives on the Ways in Which Leadership Is Demonstrated by Dietetic Students and Interns: Insights from a Canadian Study [†]

Billie Jane Chu Hermosura

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Abstract: *Background and objectives:* As food and nutrition experts, dietitians are key to quality care for numerous patients and clients. Dietitians continue to find their place within the health care hierarchy and the ways in which they can be recognized as leaders in the healthcare system. In Canada, there is a new competency domain related to dietetic leadership; however, little is known about Canadian dietitians’ leadership development. The objective was to develop a foundational understanding of how leadership skills are currently taught through dietetic education in Canada. *Methods:* A documentary analysis of 13 Canadian dietetic programs and a focus group interview with dietetic educators was conducted as one phase of a doctoral study. The interview was recorded and transcribed verbatim. A data extraction tool was used to analyze the program documents, and thematic analysis was conducted on the interview transcript. *Results:* Findings from the documentary analysis provided a snapshot of how leadership was developed in students, considering leadership was not a core competency at the time of the data collection and analysis. Focus group participants agreed with the documentary analysis findings. They talked about how personal characteristics can be developed and shared examples of how they have seen students develop their leadership skills throughout their educational experience. There was no evidence that each program had a specific definition or conceptual framework for leadership; however, some of the educators talked about distributed leadership as important to dietetic practice. Where the focus group participants began to diverge from the preliminary findings was when they began to talk about specific program elements such as curricula, program or institution requirements, and education needs requirements. *Discussion:* Dietetic educators suggest that students demonstrate leadership through their ability to critically reflect, collaborate with other classmates, and develop and implement comprehensive plans. The main way dietetic students gain leadership skills outside of the program is primarily through extracurricular activities. Many of these activities are within, but not limited to, the nutrition and dietetics profession. Dietetic educators agreed that leadership can be developed in dietetic students, although some leadership characteristics are important when applying to a program.

Keywords: dietetics; leadership development; professional competence; health professions education

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Community Pharmacy-Delivered Interventions for Nutrition and Diet-Related Health Promotion †

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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: The growing burden of nutrition-related non-communicable diseases (NCDs) across the life course is a major public health concern which needs to be addressed. Unhealthy diets are the number one risk factor for NCD-related morbidity and mortality, and along with obesity and nutrition-related chronic diseases, they are closely associated with food systems. Pharmacists are in a unique position to play an integral role in food systems transformation through educating people about modifiable behaviours such as dietary practices and healthy lifestyles. They can make an important contribution to improve public health nutrition and potentially impact the rising epidemic of obesity and diet-related NCDs through specific interventions, services, and education. This study aimed to complete a scoping review of studies of pharmacist-delivered interventions for nutrition and diet-related health promotion. Methods: A comprehensive literature search was conducted on electronic databases Medline and Embase from 2001 to 2022. Pharmacist-led interventions, including a nutrition component with the aim of improving health and nutrition behaviours, and NCDs management studies with lifestyle and nutrition behaviour change components, were eligible. Results: A total of 1244 studies were identified, and 16 studies met the criteria for inclusion. Studies included interventions for weight management, type 2 diabetes, cardiovascular health, and health education. The key components of the interventions were a combination of health and dietary education, nutritional follow-up, behaviour change through tailored counselling, goal setting, and action planning. Weight management interventions resulted in positive effects on anthropometric measures and dietary behaviour change. Interventions for the management of chronic conditions resulted with clinically significant improvement in patients' HbA1c, cholesterol, and blood pressure levels. Conclusions: The role of pharmacists is expanding beyond their traditional roles to a broader goal of delivering a range of health promotion interventions. The evidence in this review demonstrates that nutrition-related interventions in the pharmacy setting have the potential to improve both anthropometric and clinical outcomes, as well as result in dietary behaviour change. This review highlights the need for interventions that will address nutrition and dietary health goals with a “systems thinking” and a holistic life-course approach to health and food systems.

Keywords: pharmacy practice; nutrition intervention; pharmacy-delivered interventions; health promotion; public health; community pharmacy; nutrition in pharmacy practice; dietary intervention; nutrition-related NCDs; primary healthcare

Author Contributions: Conceptualization: G.A., M.H., R.F. and S.K.B.; Methodology: G.A., M.H., R.F. and S.K.B.; Analysis: G.A.; Writing: G.A.; Review and editing: M.H., R.F. and S.K.B.; Supervision: M.H., R.F. and S.K.B.; Project Administration: G.A. and M.H.; Funding acquisition: G.A. All authors have read and agreed to the published version of the manuscript.

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Predictive Value of Ankle Fracture for Osteoporosis at the Fracture Liaison Service Is Dependent on Gender and May Be Related to Alcohol Use [†]

James McMullan ¹, Emeir McSorley ¹, Rhonda Hunter ², Denise Pattison ² and David Armstrong ^{2,*}



Belgrade, Serbia, 14–17 November 2023.

Citation: McMullan, J.; McSorley, E.; Hunter, R.; Pattison, D.; Armstrong, D. Predictive Value of Ankle Fracture for Osteoporosis at the Fracture Liaison Service Is Dependent on Gender and May Be Related to Alcohol Use.

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Abstract: Osteoporosis, characterised by a reduction in bone mass, is a common musculoskeletal condition, with diet and lifestyle factors including heavy alcohol consumption now recognised to exacerbate bone loss. Fracture Liaison Services (FLS), which screen patients over 50 years who have suffered a low trauma fracture, are considered vital in the early diagnosis of osteoporosis. Although FLS has made significant contributions in preventing secondary fractures, there remains variation in patient case finding between services. Therefore, we aimed to assess the value of an ankle or wrist fracture in the diagnosis of osteoporosis taking into consideration the patient's history of alcohol consumption. Data on 500 consecutive patients observed by the FLS with either ankle or wrist fractures was surveyed. Data on gender, bone mineral density (BMD) measured by T-score, and history of heavy alcohol consumption (>28 units/week) was collected. Osteoporosis was defined as a T-score below −2.5 at any site. Logistic regression models, adjusting for age and body mass index, investigated associations between fracture type and diagnosis of osteoporosis. Data was available in 499 patients (114 M, 385 F) with 313 presenting with a wrist fracture whilst 186 presented with an ankle fracture. Some 6.8% ($n = 34$) of patients were deemed heavy alcohol consumers and over a quarter ($n = 128$) were considered osteoporotic. Males ($n = 19$) who were heavy alcohol consumers had a significantly lower hip and spine BMD (Both $p = 0.01$) when compared to those who were not. Males with an ankle fracture who were not heavy alcohol consumers also had a significantly lower risk of presenting with osteoporosis (OR 0.12, 95% CI: 0.03–0.59, $p = 0.01$). No significant differences in BMD were observed amongst females who were heavy alcohol consumers and those who were not. Additionally, no significant associations were noted between fracture type and presentation of osteoporosis in females. Assessment of alcohol consumption should be included when considering the value of ankle fractures for predicting osteoporosis in males. Future research using comprehensive assessments of alcohol consumption is warranted to confirm these findings. Focus should be placed on developing a standardised approach for assessing alcohol consumption which can be utilised across all FLS.

Keywords: osteoporosis; alcohol

Author Contributions: Conceptualization and Methodology; D.A.; data acquisition; D.A., R.H. and D.P.; formal analysis, J.M., Writing—Original draft preparation; J.M. and D.A.; writing—review and editing; E.M. and D.A. All authors have read and agreed to the published version of the manuscript. **Funding:** This research received no external funding.

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First Edition of the Albanian Food Composition Tables [†]

Luziana Hoxha ^{1,*} , Anna Giertlová ², Lenka Bartošová ², Renata Kongoli ³, Erinda Lika ⁴, Romina Koto ⁵ and Mamica Ruci ³

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: This paper aims to present a project on the publication of the first edition of food composition tables (FCTs) in Albania. Different organizations in Albania and Kosovo were contacted to provide analytical data on foods. The data for the tables were collected mainly from food labels, with less being collected from scientific papers and laboratory reports, since relevant analytical data were missing. Fifteen products were analysed by the Agricultural University of Tirana. Seventy-five foods were chosen as those most often consumed, produced, and traded in Albania (a few of them being from Kosovo). They included primary foods, pre-prepared foods, processed foods, and five traditional Albanian dishes. The collected data were documented using the Slovak database management system, Daris, v. 1.1.8. Missing values for the final list of foods were borrowed from other food composition databases. The nutritional values of dishes were calculated by using the Slovak nutritional calculation software, Alimenta, v. 4.3e. A list of a total of 48 components was included, consisting of proximates (9), minerals (9), vitamins (11), and fatty acids (19). The FCT contains 2219 records in total. The information related to the analytical methods used for each analysed parameter was described in the FCT. The bilingual (English and Albanian) version of the Albanian FCT is available for free at <https://rb.gy/jq8l0s>. Printed FCTs were disseminated through an informative seminar to the Food Control Authority, the National Authority of Veterinary and Plant Protection, and to representatives of other governmental agencies, universities, and food business operators, the national library, public health centres, and to researchers, students, and consumers. In Albania, no food composition tables have been published so far. With this first edition of the Albanian FCT, we made an effort to start building a national food composition database. This initiative was conducted in the frame of the project Development Support Programme of the Slovak Republic in Food Composition Area for Central and Eastern Europe based on the agreement between the National Agricultural and Food Centre—Food Research Institute, Slovak Republic and the Agricultural University of Tirana, Albania, during the period of 2018–2022.

Keywords: Albania; food composition tables; Daris; Alimenta



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How Can We Encourage Primary School Children to Choose and Consume High-Fibre Breakfast Products? [†]

Nicholas M. Wilkinson ^{1,*} , Katie Adolphus ², Shiniqua Coote ¹, Olivia Goldman ², Neil Boyle ²  and Louise Dye ²



Keywords: dietary fibre; breakfast; school; preference; food choice; children

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Background and Objectives: Increasing fibre consumption is a goal of UK public health nutrition, especially in low socio-economic status ('SES') groups, who consume the least fibre. Increasing accessibility and exposure to higher-fibre foods in young children could encourage consumption. Working in primary school breakfast clubs serving low SES populations, we examined children's (aged 4–11) liking and acceptance of higher-fibre breakfast foods, as part of the H3 Transforming the UK Food System project (www.h3.ac.uk, accessed on 14 June 2023). To increase familiarity and accessibility, we first offered a 'Tasteand-Rate' activity to give children an opportunity to try the foods before encountering them on the breakfast buffet. This research asked two key questions: 1. Do children like the high-fibre foods? 2. Do children choose and eat the higher-fibre foods for their breakfast? **Methods:** The high-fibre foods used were bread/toast, breakfast cereal products, porridge oats, and fresh fruit. To answer Q1, we used a simple tasting activity wherein children were offered small pieces of target foods and asked to indicate their like/dislike/ambivalence using emoji style icons printed on a tablemat. To answer Q2, we added our high-fibre food options alongside the usual school breakfast club buffet and recorded children's food choices. We also collected baseline measures of children's food choices against which to measure choices during the interventions. **Results:** This poster will report preliminary results from four schools. The results to date suggest that many children like, choose, and consume high-fibre foods when given a chance to taste and familiarise with them, and that their preferences are diverse and individual. **Discussion:** Children's preferences and selectivity in accepting foods, especially novel foods, are often noted as a barrier to healthier eating and fibre consumption. There is often an impression of parents and school food staff, for example, that 'the children only like white bread'. This research asks whether children will accept high-fibre breakfast foods, given a child-centred introduction where they can taste the foods in advance. The results will be of interest to educators, providers, and policy makers interested in school food provision and children's healthy eating, especially in low SES communities.

Author Contributions: Conceptualization, N.M.W., K.A., L.D. and N.B.; methodology, N.M.W., K.A. and L.D.; software, N/A; validation, N.M.W., S.C. and O.G.; formal analysis, N.M.W., S.C. and O.G.; investigation, N.M.W., S.C. and O.G.; resources, N.M.W.; data curation, N.M.W., S.C. and O.G.; writing—original draft preparation, N.M.W.; writing—review and editing, N.M.W., K.A., L.D. and N.B.; visualization, N.M.W.; supervision, L.D. and K.A.; project administration, N.M.W.; funding acquisition, L.D. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Opt-out caregiver consent was obtained for all child participants involved in this study. Opt-out consent was used because data was collected anonymously.

Data Availability Statement: Data for this study is not yet published.

Conflicts of Interest: The authors declare no conflict of interest.

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Implementing Nutrient Recommendations for Breakfast in Europe through Dietetic Practice—The European Federation of Associations of Dietitians (EFAD) Breakfast Toolkit Survey [†]

Elena Alonso-Aperte ^{1,*} , Angela García-González ¹ , Marta Maroto-Novalbos ¹, Klaus Nigl ², Elisabeth Farmer ², Eva Hoelzl ² and Ezgi Kolay ³



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Abstract: Background and objectives: The International Breakfast Research Initiative developed nutrient recommendations for a balanced breakfast, based on daily guidelines and actual contribution of breakfast in Europe. The aim of the Breakfast Toolkit Project is to translate nutrient recommendations into practical advice for both individuals and health professionals, and to develop a toolkit for dietitians. Methods: We conducted a 19-item online survey to assess the experience and resources of dietitians when recommending breakfast as part of a balanced diet. Results: A total of 336 dietitians from 27 countries participated in the survey. Forty-nine percent were working in clinical practice or private consulting. Around 50% thought that the general population is somewhat aware of the impact of breakfast on health, with the highest number of people not being aware in northern Europe. A lack of time and not feeling hungry in the morning are the main obstacles to achieve a healthy breakfast all over Europe, while a lack of money is more concerning in central and eastern Europe than other areas. Although slight differences are observed between European regions, increasing fresh fruit and vegetables (17%), decreasing sugary food (14.5%), and switching to whole grain cereals (18%) are the most peremptory needed interventions, according to the experience of the dietitians. Educational materials focused on breakfast are scarce and would be appreciated by dietetics practitioners. Breakfast printed infographics and recommendations are the most valued tools (39%), followed by examples of healthy recipes and menus (21%). Discussion: Nutritional quality of breakfast is an overall problem in Europe that dietitians need to address in any setting in which they work. Dietary malpractices at breakfast are the same in all countries, as are the obstacles people face when trying to improve the quality of breakfast. Thus, common evidence-based dietary guidelines and educational materials will help dietitians work in implementing healthy breakfast habits in the European population. Printable online materials, to be used in consultancy, and culinary tips are the most appreciated tools by practitioners.

Keywords: breakfast; dietary counseling; nutrition education

Author Contributions: Conceptualization, E.A.-A., A.G.-G., K.N. and E.K.; methodology, E.A.-A., A.G.-G., K.N., E.F. and E.H.; validation, E.A.-A., K.N. and E.K.; formal analysis, A.G.-G.; investigation, A.G.-G., M.M.-N. and E.H.; resources, E.F., E.H. and M.M.-N.; data curation, A.G.-G., writing—original draft preparation, E.A.-A., K.N., E.F. and E.K.; writing—review and editing, E.A.-A., A.G.-G. and E.K.; supervision, E.K.; project administration, E.K.; funding acquisition, E.A.-A., A.G.-G., K.N. and E.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: Ethical review and approval were waived for this study due to the nature of data recorded and the totally anonymous surveying process.

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Meeting the Diabetes and Hypertension Targets of the National Cardiovascular Program in the Most Rural Region of Chile (2018–2020) [†]

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Abstract: Background: The national cardiovascular program includes medical, nursing, and dietetic interventions, which lack evaluation. Therefore, this study aims to evaluate the accomplishment of diabetes and hypertension targets in users of the national cardiovascular program in the Ñuble region between 2018 and 2020. Methods: A cross-sectional study was carried out on users enrolled in the national cardiovascular health program with T2D and/or HTA in the Ñuble region between 2018 and 2020. To evaluate the association between target goals (glycosylated hemoglobin (HbA1c) and blood pressure) and sociodemographic variables, linear and logistic regression were used. Results: More than 16,000 users were included. Men had higher HbA1c levels than women. Meanwhile, for age, people older than 65 years had lower HbA1c levels; a similar tendency was observed when comparing people older than 80 years. When the comparison was performed for rurality, people living in rural areas had higher HbA1c levels, and these levels were higher among people living in Itata province. This tendency was slightly different among HTA people; men continued to exhibit higher levels of Systolic Blood Pressure (SBP) through the years, older people had higher levels of SBP, and people living in rural areas had lower levels compared to people living in urban areas. Conclusion: The present study allows us to deliver the first results regarding the operation of the national cardiovascular health program in the Ñuble region, which allows us to determine if the goals of achievement for T2D and HTA have decreased in the period 2018–2020.

Keywords: diabetes; hypertension; cardiovascular health; public health; national cardiovascular program

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Holistic Approach to Celiac Patient Support: Nutritional Education of the Social Environment of People with Celiac Disease [†]

Maialen Vázquez-Polo ^{1,2,*} , Virginia Navarro ^{1,2}, Gesala Perez-Junkera ^{1,2}, Idoia Larretxi ^{1,2,3} , Arrate Lasa ^{1,2}, Jonatan Miranda ^{1,2} and Itziar Churruca ^{1,2} 



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Abstract: Celiac disease (CD) is a chronic, multifactorial and autoimmune-based disease. Genetically predisposed individuals respond to gluten by triggering an immune response resulting in various gastrointestinal and extra intestinal symptoms. The only treatment for the disease is a strict, lifelong gluten-free diet (GFD). The GFD aims at physical health, but at the same time, it has an enormous influence on the quality of life of people with CD, especially on a social level. People with CD have problems eating out and attending events and celebrations. Therefore, it is believed that generalized knowledge and awareness of the disease in the general population could improve their situation. To this end, various nutritional education programs have been designed and are being implemented in order to raise awareness of celiac condition among the general population. Interventions have been designed to be carried out in: (a) schools, with primary school children learning about celiac disease through games and experiments, (b) workshops in catering schools, (c) workshops in the context of science fairs for secondary school children. Early results show that participants are increasing their knowledge of GFD, and the interventions are effective in bringing the diseases closer to the general population. It is necessary to treat the disease from a broad approach, beyond physical wellbeing. Social well-being must also be sought, as it is an important and forgotten factor of the quality of life of these people.

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Keywords: celiac disease; nutrition education; quality of life; children; catering; school

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Author Contributions: I.C., V.N. and M.V.-P. conceived and designed the study; M.V.-P. and G.P.-J. participated in the design of questionnaire; J.M., A.L. and I.L. participated in the recruitment, the data collection, and together with I.C., V.N. and M.V.-P. contributed in statistical analysis; I.C., V.N. and M.V.-P. drafted the manuscript. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study prior to the start of the study. Schools, teachers and parents/guardians of the children agreed to participate in the study by signing an informed consent form. Members of the research group physically collected the signed informed consents forms, which were securely stored in the department of the group. The informed consent to be signed included a consent to publish the results of the intervention, in general terms, in an open access journal.

Data Availability Statement: Data are contained within the article.

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Nutrition-Competency and Attitude towards Nutrition Counseling among Graduating Medical Students [†]

Ludmila Ivanova ^{1,*} , Rosica Popova ¹  and Vania Birdanova ²



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There is no minimum standard of compulsory hours designated for nutrition in Bulgarian medical universities, nutrition classes are elective, and total assigned academic hours vary from 15 to 30. The aim of the current survey was to assess the self-perceived confidence in nutrition knowledge and skills of medical interns, obtained during medical training. Methods: A cross-sectional survey was conducted in February–March 2023. A total of 15 survey questions were formulated to assess the comprehensive medical training, nutrition knowledge and practical skills in dietary assessment, and preparedness to provide nutrition guidelines and dietary counselling. A five-point Likert scale was applied to assess the level of confidence. Results and discussion: A total of 53 interns responded to the survey with a response rate of 44%. Most participants were well confident about the diet-non-communicable disease relationship (64%), body composition and chronic diseases (76%), and the effect of diet on type-2-diabetes (68%), but fewer were familiar with food-drug interactions (8%) and were not prepared to provide food-based dietary guidelines to patients (12%). The interns were confident when interpreting laboratory nutrition tests (68%) and were ready to use anthropometric measurements (60%). About one-third of interns fully agreed that evaluation of nutritional status (36%) and dietary intake (28%) should be a part of every patient’s routine examination and 28% thought that nutrition counselling was not a part of their duties. Only 12% of the respondents were confident in their capacity to provide nutritional consultations. The strengthening of the medical curriculum with more mandatory nutrition classes will benefit physicians’ capacity in diet therapy counselling.

Abstract: Background and objectives: Diet is a leading modifiable factor for the development of noncommunicable diseases. The effective use of dietary interventions and advice should be an integral part of clinical care and medical doctors should be the most reliable and trusted source of nutrition information. The adequacy of nutrition training in medical education remains an issue of concern and most graduating medical students rate their nutrition competency as inadequate.

Keywords: nutrition training; medical curricula; graduates’ awareness

Author Contributions: Conceptualization, L.I. and R.P.; methodology, L.I.; software, L.I.; validation, L.I. and R.P.; formal analysis, L.I.; investigation, L.I., R.P. and V.B. data curation, L.I., R.P. and V.B. writing—original draft preparation, L.I.; writing—review and editing, L.I. and R.P.; visualization, R.P.; supervision L.I. All authors have read and agreed to the published version of the manuscript.

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Food Safety Knowledge, Attitudes and Practices among Bulgarian Young People [†]

Vanya Boycheva (Birdanova) *, Ivelina Ruseva, Tsvetelina Vitkova and Irena Stoilova



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objective: Providing a population with quality and safe food is one of the main public health problems worldwide. The aim of the present study was to assess the food safety knowledge, attitudes and self-reported food handling practices among a Bulgarian young population. Methods: A cross-sectional survey was conducted among 60 young people from the Pleven region, Bulgaria, aged 20–29. A pre-tested structured questionnaire was used to collect data on the purchase, storage, preparation, culinary processing and serving of food in a home environment, and also on the demographic profile of the respondents. IBM SPSS v.25 software was applied with a level of statistical significance set at $p < 0.05$. Results: This study showed that a high proportion of the participants had good levels of knowledge and practices for culinary processing of food—73.9%, food preparation—68.7% and food serving—67.2%. More than half of the participants (59.5–58%) gave correct answers about buying and storing food at home. The highest score was established for the shelf life of products—0.8; rapid cooling of animal foods—0.74; washing fresh fruits and vegetables before consumption—0.94; keeping dishes and utensils in the kitchen clean—0.89; adequate heat treatment of food and quality of drinking water—0.75. A lower percentage of correct answers was found about buying organic food and eating in front of a computer and a mobile device—0.38–0.42. Discussion: The outcome of the survey showed that knowledge, attitude and practice among young people to ensure quality and safe food were at a good level. For young people, educational programs can be developed related to the purchase of organic foods and the optimization of the digital health and food safety interaction.

Keywords: knowledge; attitude; practice; food safety

Author Contributions: Conceptualization, V.B.; methodology, V.B., I.R., T.V. and I.S.; software, I.R. and V.B.; validation, V.B., I.R., T.V. and I.S.; formal analysis, V.B., T.V. and I.R.; investigation, V.B., I.R., T.V. and I.S.; data curation, I.S.; writing—original draft preparation, V.B. and I.R.; writing—review and editing, V.B., T.V. and I.R.; supervision, V.B.; project administration, V.B.; funding acquisition, V.B. All authors have read and agreed to the published version of the manuscript.

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The Use of Dietary Supplements in Cancer Patients [†]

Nevena Corić ^{1,*} , Ana Vukoja ² and Ines Banjari ³ 



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: The use of dietary supplements is extremely common among cancer patients. It is estimated that 20–90% of cancer patients use some form of dietary supplement. Most often, they are “self-selected” supplements or selected from unverified Internet sources, without consulting a specialist. Components in such supplements can interact with the applied therapy and impact cancer patients’ treatment. The aim of this study was to examine the frequency and type of supplementation used by cancer patients. Methods: A cross-sectional observational study was conducted on 52 cancer patients (mean age: 58 years) by using a study-specific questionnaire, conducted between February and July 2022 at the University Clinical Hospital Mostar, Bosnia and Herzegovina. Results: More than half of the respondents (62%) use some dietary or herbal supplements daily. The most common dietary supplements were probiotics (22%), B complex vitamins (22%), and vitamin D (22%). Patients (46.8%) used supplements based on their own or their family–friend’s recommendation, and 90% of them started to use supplementation during therapy. The main reason for use, as stated by 71.8% of the respondents, was to support immunity. Approximately 56.2% of them said that they had noticed a positive effect on their health. It is concerning that 78.8% of patients did not research the possible side effects and risks of taking supplements during therapy. Conclusions: Doctors, nutritionists, and nurses should improve communication with patients by giving them reliable information and evidence-based recommendations about dietary supplements and complementary therapy in general. During consultations, professionals should offer assistance and discuss potential benefits and risks with the patient in order to achieve a mutually informed decision on dietary supplement use.

Keywords: cancer patients; dietary supplements; nutrition counseling

Author Contributions: Writing and conceptualization: N.C., A.V. and I.B.; investigation and data collection: N.C.; validation: A.V. and I.B.; statistical analysis: A.V. and N.C.; writing—review and editing: N.C. and A.V.; supervision: I.B.; project administration: N.C., A.V. and I.B.; All authors have read and agreed to the published version of the manuscript.

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Promotion of Fruit Consumption Using Nutrition and Health Claims: Sufficiency of Available Data on Nutrition Composition [†]

Anita Kušar ^{1,*} , Kerstin Pasch ² and Igor Pravst ¹ 



Citation: Kušar, A.; Pasch, K.; Pravst, I. Promotion of Fruit Consumption Using Nutrition and Health Claims: Sufficiency of Available Data on Nutrition Composition. *Proceedings* **2023**, *91*, 129. <https://doi.org/10.3390/proceedings2023091129>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Fruits constitute a dietary source of many essential nutrients and other bioactive substituents. Unfavorable trends in the consumption of fruits can be addressed with increased promotion and also using nutrition and health claims because an important segment of consumers is sensitive to health-related communications. The regulation on the use of nutrition and health claims only allows the use of claims when the product is a relevant source of the nutrient referred to. Food composition databases (FCDBs) offer such data, but it should be highlighted that, in practice, the composition of fruits can vary notably due to the variety, agricultural practices, soils, and climatic conditions. The objective of the present study was to investigate data on the nutritional composition of selected widely available apple varieties in Europe for health promotion purposes. We focused on samples available to consumers at the end of the season (winter). The comparison of existing data from FCDBs with new nutritional composition data from laboratory analyses for health promotion purposes was performed for four studied apple varieties (Golden Delicious, Gala, Idared, and Braeburn). The amount of vitamin C in the observed samples varied up to 15.3 mg, and the dietary fibres varied from 3.3 to 5.5 g in 100 g of apple in laboratory testing. Only the Braeburn variety contained a sufficient amount of vitamin C for the use of nutrition and health claims, while the content of dietary fibre was sufficient for all varieties. The data from laboratory testing differed from the data from FCDBs, which are not specific to the variety. The findings indicate a moderate acceptability of data on nutritional composition from FCDBs for the use of nutrition and health claims for apples, especially when the content of nutrients is on the borderline of the conditions for the use of claims, as in the case with vitamin C. Consequently, additional research on the variability of vitamin C in apples is needed, especially in relation to the variety and storage conditions/duration. The amendment of FCDBs with composition data at the level of fruit variety would present an important aspect for the nutrition and health promotion of fruits.

Keywords: apples; nutrition composition; nutrition and health claims; food composition databases; vitamin C; fruit promotion; bioactive compounds

Author Contributions: Conceptualization, A.K.; methodology, A.K. and I.P.; investigation, A.K.; resources, I.P. and K.P.; data curation, A.K.; writing—original draft preparation, A.K.; writing—review and editing, A.K.; supervision, I.P. and K.P.; project administration, A.K.; funding acquisition, I.P. and K.P: All authors have read and agreed to the published version of the manuscript.

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Alimentación S2: An App-Based Intervention to Promote Sustainable Healthy Diets [†]

Ujué Fresán ^{1,*}, Paquito Bernard ², Sergi Fàbregues ³, Anna Boronat ⁴, Vera Araújo-Soares ⁵,
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Abstract: Background and objectives: Changing dietary patterns into sustainable healthy diets is urgent. So far, few behavior change interventions have addressed all dimensions of dietary sustainability (i.e., nutrition and health, economic, socio-cultural, and environmental) at once. Cuttingedge methodologies, such as eHealth, could be an appealing way to implement such interventions. This pilot study aimed to assess the acceptability and effectiveness of an app-based behavior change intervention, promoting the adoption of a sustainable healthy diet. Methods: Twelve participants were enrolled in a one-year n-of-1 clinical trial (2-week baseline + 22-week intervention + 24-week follow-up). The intervention consisted of push notifications (educational, motivational, or recipes) through an app, as well as scheduled individualized online feedback sessions. The consumption of 10 key food groups for a healthy diet with a low environmental impact was monitored daily on fifteen weekly bursts spread throughout the study by means of an app-based validated questionnaire. Other key aspects for a sustainable diet (e.g., socio-economic or food waste) and the acceptability of the intervention were assessed qualitatively through three interviews. Results: Throughout the study, dietary patterns of 10 out of 12 participants were more aligned with an environmentally sustainable healthy diet. Two of the participants did not modify their diet substantially. The consumption of fruits and vegetables, legumes, and whole grains increased over time, while that of red and processed meat decreased. Diverse results were observed for dairy products and ultraprocessed foods. Over time, half of the participants reported an increased concern for the socioeconomic dimension of dietary sustainability, and 70% reported an increased concern about food waste. Participants provided positive feedback on the text messages they received, the utility of the individual online feedback sessions, and the adequacy of the frequency of response and the ease with which the app-based dietary questionnaire is answered. Conclusions: This pilot study implemented through eHealth technology was effective for changing eating behaviors towards a sustainable healthy diet. The methodology and materials developed can be useful in designing future large-scale interventions.

Keywords: sustainable diet; mobile health; digital health; eHealth; mHealth; dietary environmental impact; eating behavior; dietary sustainability

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Women’s Knowledge of Good Nutrition and Feeding Practices Is Correlated with Their Level of Exposure to Awareness-Raising Activities in Ouagadougou [†]

Mélanie Antoine ^{1,*}, Stéphanie Zoungrana ¹, Jérôme W. Somé ², Hermann B. Lanou ², Séni Kouanda ²  and Claire Mouquet-Rivier ¹ 



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Abstract: Malnutrition still affects the population in low-income countries. In Burkina Faso, the estimated prevalence of anemia is high among preschool-aged children and women of childbearing age (83.4% and 53%, respectively in 2014). As part of the MERIEM fortification project, a survey was carried out in 2022 in Ouagadougou to describe dietary practices and women's knowledge. The aim of this work is to assess the association between exposure to nutrition sensitization campaigns and women's knowledge of nutrition. A cross-sectional survey conducted in Ouagadougou in March 2022 involved 794 randomly selected women. Socio-economic data were collected, and knowledge scores on breastfeeding (BF; max 9), complementary feeding practices (IYCF; max 8) and

nutritional status (NS; max 7) of young children, the feeding practices of pregnant (PW; max 4) and breastfeeding women (BW; max 4), and fortified products (FP; max 18) and vitamins and minerals (VM; max 13) were calculated. Exposure to nutrition sensitizations was categorized as low, moderate, or high. Linear regression models (performed with R software version 4.3.0) were used to analyze the association between knowledge scores and household wealth quintiles, as well as the association between knowledge scores and sensitization scores from the MERIEM project, adjusted for wealth quintiles. Mean scores measured in the sample are 4.7, 2.9, 2.6, 1.4, 1.8, 2.7, and 3.1 for BF, IYCF, NS, PW, BW, FP, and VM, respectively. Knowledge scores increased significantly ($p < 0.001$) with socio-economic status, except for NS, PW, and BW scores. In total, 78.0% of women had a low level of awareness and only 6.3% had a high level. Exposure to nutrition awareness campaigns increases all women's knowledge, but not for breastfeeding. This is probably due to the wide promotion of breastfeeding practices among the population, particularly in health centers. The MERIEM-specific project's awareness-raising activities are overall not associated with knowledge scores. However, there was a significant association with IYCD and VM scores ($p < 0.05$). Knowledge of diet and nutrition is overall low in Burkina Faso. Raising awareness seems to have a positive effect on knowledge levels and can be a lever in the fight against malnutrition. Further research is needed to determine whether improved knowledge scores translate into improved practices.

Keywords: nutritional knowledge; sensitization; women of childbearing age; sub-Saharan Africa

Author Contributions: Conceptualization, S.Z., J.W.S., H.B.L., S.K. and C.M.-R.; Methodology, S.Z., J.W.S., H.B.L. and C.M.-R.; Investigation, S.Z., J.W.S. and H.B.L.; Formal Analysis, M.A.; Data Curation, S.Z. and M.A.; Writing—Original Draft Preparation, M.A.; Writing—Review & Editing, C.M.-R. and M.A.; Supervision, C.M.-R.; All authors have read and agreed to the published version of the manuscript.

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Marketing or Transparency? A Study into Misleading Labelling: With Food Experts, Consumers and the Food Sector [†]

Annet J. C. Roodenburg ^{*} , Nadja Hanssen and Gerlinde van Santen



Citation: Roodenburg, A.J.C.; Hanssen, N.; van Santen, G. Marketing or Transparency? A Study into Misleading Labelling: With Food Experts, Consumers and the Food Sector.

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food labelling legislation, there is room for marketing departments in the food industry to seduce consumers with misleading labelling, for example by using pictures of fresh fruits or vegetables that are only present in tiny amounts in the product, or by using terms such as ‘no added sugar’, ‘natural’, ‘healthy’ or ‘fresh’, misleading portion sizes and fun characters for kids. Consumers need help in making the actual healthy choice. So, what needs to be done and by whom? **Methods:** Several studies were carried out: Semi-structured interviews ($n = 7$) with food experts on roles and responsibilities of different parties and possible solutions. Based on an inventory of misleading food labels, a categorization was made together with the help of food experts. The eight defined categories were evaluated in quantitative ($n = 1117$) and qualitative ($n = 26$) consumer studies. A selection of legislative measures against misleading labelling that are already available in other countries were evaluated in 12 semi-structured interviews with representatives from the food industry. **Results and Discussion:** Consumers indicated that the top three categories of most misleading labelling were (1) the suggestion of product qualities that are not present or are only present in tiny amounts; (2) blurring of unhealthy ingredients; and (3) incorrect use of nutrition claims. Misleading labelling was mostly found on cookies, bars and non-alcoholic drinks. In general, the representatives of the food industry agreed on the need for legislation to prevent blurring of unhealthy nutrients and incorrect use of nutrition claims. Suggesting product qualities that are not present or are present in tiny amounts was of a lower priority according to the interviewees. It was indicated that there is a tension between the marketing and quality roles within a food company. With respect to roles and responsibilities, there was an agreement that the food producers were responsible for what is on their packages, the government is responsible for the legislation and the consumers are responsible for their own food choices. However, everyone doubts whether the consumers understand enough to be able make healthier choices.

Keywords: misleading labelling; legislation; kids marketing; consumers

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Author Contributions: N.H. and A.J.C.R. contributed to the project plan, supervised and carried out the studies and wrote the abstract. G.v.S. contributed to the project plan and the abstract. All authors have read and agreed to the published version of the manuscript.

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Abstract: Background and objectives: Despite the current

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Daily Lactose Supplementation in Lactase Non-Persistent Individuals Induces Colonic Adaptation and Reduces Intolerance Symptoms [†]

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Abstract: Background and objectives: Globally, about 70% of the adult population is lactase nonpersistent (LNP), lacking the enzyme required for lactose digestion. The main consequence of intolerance is withholding nutrient-rich dairy foods, while the literature shows that many LNPers are able to consume ≤ 12 g of lactose, comparable to 250 mL of milk, without experiencing gastrointestinal discomfort. Repetitive consumption of lactose may improve intolerance symptoms even further via colonic adaptation. This study aimed to assess the effects of daily consumption of incremental lactose doses on microbiota composition and function, and intolerance symptoms. Methods: Twenty-five healthy adults of Asian origin (age 22–44 yrs, BMI 19–28 kg/m²), carrying the LNP genotype and avoiding lactose in their habitual diet, were included in this 12-week single-blinded intervention trial. Participants consumed lactose twice daily, with doses being gradually increased from 3 to 6 g, to finally 12 g twice daily, each dose being provided for 4 consecutive weeks. Before and after the 12-week intervention, participants underwent a 25 g lactose challenge hydrogen breath test (HBT) and handed in stool samples. Daily gastrointestinal symptoms and acute intolerance symptoms during the HBT were recorded. Results: There was a significant increase in Bifidobacterium after 12 weeks of lactose consumption ($p = 0.009$), accompanied by a two-fold increase ($p < 0.001$) in fecal β -galactosidase activity. There was a 1.5-fold decrease (AUC; $p = 0.01$) in expired hydrogen during the second compared to the baseline HBT. There was a non-significant decrease in total symptom score ($p = 0.09$) during this second HBT, which was already relatively low during the baseline HBT. Daily consumption of lactose was generally well tolerated, with mild to no gastrointestinal complaints reported during the intervention. Discussion: Repetitive consumption of incremental doses of lactose increases lactose tolerance in LNP individuals via colonic adaptation, most likely through increasing the relative abundance of lactose-fermenting Bifidobacterium. Repetitive lactose consumption is well tolerated and able to reduce expired hydrogen during a 25 g lactose HBT. Here, we show that regular and incremental exposure to lactose in LNP individuals leads to colonic adaptation without any increase in gastrointestinal symptoms. This lifts the necessity to remove dairy foods completely from the diet.

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Keywords: lactose intolerance; Bifidobacterium; β -galactosidase activity; colonic adaptation; hydrogen breath test

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Dutch Consumers' Attitude toward (Ultra) Processing of Food [†]

Sylvie Huybers ^{1,*}, Dieuwerke P. Bolhuis ²  and Annet J. C. Roodenburg ¹ 



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Recently, industrial (ultra) processing of foods and its possible adverse effects on health have been widely debated in scientific literature and media. There is not much known about consumers' attitudes toward the (ultra) processing of foods. Therefore, a survey was distributed ($n = 463$) and interviews ($n = 11$) were conducted with Dutch adult consumers to evaluate consumers' attitudes and associations towards industrial food processing and to assess opinions about communications on food processing and health. The results showed that 51% of the consumers had a neutral attitude, 23% had a positive attitude, and 26% had a negative attitude towards food processing. Most respondents (75%) were not familiar with the term ultra-processed foods, especially those with a neutral attitude compared to those with a positive or negative attitude ($p < 0.001$). The survey showed that 69% of the respondents thought food processing had a (slightly) negative health effect, 17% did not know, and 9% indicated (slightly) positive health effects. Associations with industrial processing were as follows: additives, artificial, not fresh, low nutritional value, and unnatural, but also food safety, and convenience. All three attitude groups (negative, neutral, and positive) indicated both positive and negative associations. Respondents of the survey who were indicated to be (slightly) related to food/nutrition by profession ($n = 159$) more frequently had a positive attitude towards food processing ($p = 0.008$). Furthermore, many interviewees indicated that communication on food is scattered and chaotic. There is a need for clear and understandable information from a central source, especially for those with negative attitudes. In addition, 77% of the survey respondents with a negative attitude towards food processing indicated that they would like to have more information about nutrition and food (processing). In conclusion, most Dutch consumers in this study population have a neutral and nuanced attitude towards industrial food processing. Those with a background or connection with food via profession showed a more positive attitude, which may indicate a need for clear communication and education about nutrition, ingredients, and food processing.

Keywords: food processing; consumer; communication

Author Contributions: Conceptualization, S.H., D.P.B. and A.J.C.R.; methodology, S.H., D.P.B. and A.J.C.R.; software, S.H. and D.P.B.; validation, S.H. and D.P.B.; formal analysis, S.H. and D.P.B.; investigation, S.H. and D.P.B.; resources, S.H. and D.P.B.; data curation, S.H. and D.P.B.; writing—original draft preparation, S.H. and D.P.B.; writing—review and editing, S.H., D.P.B. and A.J.C.R.; visualization, S.H. and D.P.B.; supervision, S.H. and D.P.B.; project administration, S.H. and D.P.B.; funding acquisition, S.H. and D.P.B. and A.J.C.R. All authors have read and agreed to the published version of the manuscript.

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Development of a Method to Measure a Biomarker Panel Reflecting Dietary Exposure [†]

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Abstract: Assessment of dietary intake remains a large challenge in nutrition studies. The application of food intake biomarkers is a promising approach to complement widely used self-reported intake assessments and to improve accuracy. The development of metabolomics has enabled the discovery of many potential food intake biomarkers, but their applications are still limited. We aim to develop a semi-quantitative LC-MS/MS procedure to analyze a panel of plasma metabolites reflecting dietary exposure in a wide context. Our approach relies on a multi-analyte targeted LC-MS/MS method using a LC-QTRAP and commercially available reference compounds. A panel of 347 metabolites was selected, representing dietary intake (fruits and vegetables, coffee, tea, heat-treated food, wholegrain cereals, berries, cruciferous vegetables, and seafood) and key metabolites in the endogenous metabolism (fatty acids, amino acids, cholesterol metabolism, Krebs cycle, bile acids, and microbial metabolism) which are affected by specific diets, as well as lifestyle exposures, such as smoking and alcohol consumption. The application of this panel will help in assessing dietary exposures and their relationships to health outcomes. We will present the status of the work.

Keywords: dietary biomarkers; multiple reaction monitoring; LC-MS; plasma metabolites; endogenous metabolism



Citation: Noerman, S.; Armeni, M.; Di Pede, G.; Gonzalez-Domínguez, R.; Savolainen, O.; Landberg, R. Development of a Method to Measure a Biomarker Panel Reflecting Dietary Exposure. *Proceedings* **2023**, *91*, 421. <https://doi.org/10.3390/proceedings2023091421>

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Development of a Method to Measure a Biomarker Panel Reflecting Dietary Exposure †

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Abstract: Assessment of dietary intake remains a large challenge in nutrition studies. The application of food intake biomarkers is a promising approach to complement widely used self-reported intake assessments and to improve accuracy. The development of metabolomics has enabled the discovery of many potential food intake biomarkers, but their applications are still limited. We aim to develop a semi-quantitative LC-MS/MS procedure to analyze a panel of plasma metabolites reflecting dietary exposure in a wide context. Our approach relies on a multi-analyte targeted LC-MS/MS method using a LC-QTRAP and commercially available reference compounds. A panel of 347 metabolites

was selected, representing dietary intake (fruits and vegetables, coffee, tea, heat-treated food, wholegrain cereals, berries, cruciferous vegetables, and seafood) and key metabolites in the endogenous metabolism (fatty acids, amino acids, cholesterol metabolism, Krebs cycle, bile acids, and microbial metabolism) which are affected by specific diets, as well as lifestyle exposures, such as smoking and alcohol consumption. The application of this panel will help in assessing dietary exposures and their relationships to health outcomes. We will present the status of the work.

Keywords: dietary biomarkers; multiple reaction monitoring; LC-MS; plasma metabolites; endogenous metabolism



Citation: Noerman, S.; Armeni, M.; Di Pede, G.; Gonzalez-Domínguez, R.; Savolainen, O.; Landberg, R.

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Potential of Plasma Oxylin Signature to Better Understand the Relationships between Diet, Fatty Acids and Oxylin in Healthy Individuals: New Insights from Two Independent Cohort Studies [†]

Cécile Gladine ^{1,*}, Nils Schebb ², Mathilde Touvier ³ , Arne Astrup ⁴ , Philip Calder ⁵, Andrzej Szuba ⁶ 
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Abstract: Eicosanoids and other oxylin represent a superfamily of bioactive lipids involved in the regulation of crucial biological processes such as inflammation, blood clotting or endothelial reactivity. Oxylin are generated from polyunsaturated fatty acids (PUFAs) through various enzymatic and free-radical-mediated reactions. Interestingly, each metabolic step (PUFA availability, enzyme activity and oxidative stress) can be influenced by diet. Oxylin could therefore be important mediators of the effects of diet on human health. To provide new insights into the relationships between oxylin, fatty acids (FAs) and diet, we conducted two independent cohort studies nested in the Polish branch of the PURE international cohort and in the French Nutrinet-Santé cohort, respectively. The selected participants (n = 318) were healthy and fully characterized for their dietary intake. Our first objective was to determine if a healthy diet was associated with a specific oxylin signature. Our secondary objective was to comprehensively investigate the relationships between diet, FAs and oxylin.

Participants were distributed into two groups according to the quality of their diet (based on the Alternative Healthy Eating Index (AHEI)). Targeted lipidomics was performed to comprehensively quantify plasma oxylin and FAs. The association between oxylin, FAs and the quality of the diet was modeled using conditional logistic regression. The relationships between oxylin, FAs and diet were investigated using an unsupervised multiblock analysis (Multiblock Factorial Analysis (MFA)). We generated a unique database revealing unsuspected associations between diet, FAs and oxylin. Validation studies are now required to further explore the potential of oxylin to monitor the health effects of diet.

Keywords: lipid mediators; lipidomic; oxylin; diet; health

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P.C., A.S. and J.N.; visualization, C.G.; project administration, C.G.; funding acquisition, C.G., N.S., A.A., A.S. and M.T. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Any data or material that support the findings of this study can be made available by the corresponding author upon request.

Conflicts of Interest: The authors declare no conflict of interest.

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Social Network and Sentiment Analysis of the #Nutrition Discourse on Twitter [†]

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Abstract: Social media platforms allow people to share information, connect, and build networks at an unprecedented scale with positive and negative consequences. Social network analysis (SNA) applies

mathematical network and graph theory to visualise information transfer as relational networks of connected nodes. Measuring node connectivity (centrality) permits the identification of ‘influencers’. SNA has been applied to analyse the spread of misinformation on Twitter (1), but to date, no research has examined nutrition networks. Therefore, this study examined the #Nutrition conversations on Twitter utilising SNA and linguistic analyses. English language tweets including ‘#Nutrition’ on

1–21 March 2023 were collected using the SNA tool, NodeXL Pro (Network Overview for Discovery and Exploration in Excel) (2). SNA is a multistep process that calculates graph metrics and develops a network graph to measure the relationships between users. SNA also identifies semantically related words, hashtags, and word pairs and identifies the sentiment of words used, as measured against the Opinion Lexicon (2). The #Nutrition network included 17,129 vertices (users) with 26,809 unique edges (connections); edges with duplicates were merged. The network density was low, suggesting that most users communicate heavily with a small number of users. The average geodesic distance between any two users was 5.26, revealing a dispersed online discussion. SNA identified the top

10 influencers in this network, measured by high betweenness centrality (23,375,543–5,207,998). Influential users were from a mix of accounts including personal, online blogs, and government organisations. High betweenness centrality identified the users with the greatest influence, acting as bridges between network groups and therefore amplifying #Nutrition messages. Sentiment analysis found the discourse was more positive (0.047, 22,218 words) than negative (0.015, 6795 words). Semantic analysis calculated the total words, 468,191, and identified the most frequently used words in the tweets: #nutrition, #health, food, more, nutrition, health, #diet, #healthylifestyle, #fitness, and #food. Social network analysis shows the discourse on Twitter relating to #Nutrition is dispersed without clear polarising views. Semantic analysis showed that ‘health’ was the main topic discussed in relation to nutrition in this network and was most frequently associated with #Nutrition. The narrative was positively framed, as identified through sentiment analysis.

Keywords: Twitter; social network analysis; networks; semantic analysis

Author Contributions: Conceptualization, C.H.E., C.E.L.E. and J.B.M.; methodology, C.H.E.; software, C.H.E.; formal analysis, C.H.E.; data curation, C.H.E.; writing—original draft preparation, C.H.E.; writing—review and editing, C.H.E.; supervision, C.E.L.E. and J.B.M. All authors have read and agreed to the published version of the manuscript.

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Photovoicing versus Protein Food Frequency Questionnaire: Differences and Similarities in Measuring the Protein Intake of Community-Dwelling Older Adults [†]

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Citation: Linschooten, J.O.; Verwijs, M.H.; de van der Schueren, M.A.E.; Roodenburg, A.J.C. Photovoicing versus Protein Food Frequency Questionnaire: Differences and Similarities in Measuring the Protein Intake of Community-Dwelling Older Adults. *Proceedings* **2023**, *91*, 251. <https://doi.org/10.3390/proceedings2023091251>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Research has shown that approximately 50% of Dutch older adults have a protein intake < 1.0 g/kg bw/day, and new strategies to improve protein intake have been suggested. Information on protein consumption can be collected via FFQs such as the Protein Screener 55+, but recent outcomes have shown that older adults may be incapable of estimating their own dietary intake. The aim of this study was to compare the reported intake in the Pro55+ with an estimate of protein intake based on photos taken over a period of 7 days to identify how accurate elderly people are in estimating their habitual protein intake over a period of 4 weeks. Protein intake was assessed in interviews using the food frequency questionnaire Pro55+, calculating the risk of a low protein intake (<1.0 gr/kg bw/day). The participants (n = 9) were asked to take photos of everything they consumed for a period of seven consecutive days and were asked whether they modified their consumption behaviour due to photographing. The reported frequency of consumption of products as categorized in the Pro55+ was compared with the frequency of foods visible in the photos as an indication for actual consumption. A Pro55+ score > 30% indicates a high risk of low protein intake (<1.0 gr/kg bw/day). The average Pro55+ score from the interviews was 44.9%, while the average photovoicing-based Pro55+ score based on the observed data was 54.9%. In eight out of nine cases the participants overestimated the frequency of nuts/peanuts consumption as well as dairy products like yoghurt (six out of nine). On the contrary, consumption of eggs was underestimated by six out of nine participants. The Pro55+ is a validated screening tool for the risk of a low protein intake based on the consumption of specific groups of food items that have shown to have the highest predictive value. However, this easy-to-use tool depends on the self-reported intake of these items by older adults. The comparison of the reported intakes with the photos of meals and food products showed that it appeared to be difficult for older adults to give accurate estimates, which may suggest that older adults are also insufficiently aware of necessary modifications to their current behaviour to adhere to dietary guidelines, such as an increased protein intake.

Keywords: older adults; protein intake; dietary assessment methods

Author Contributions: J.O.L. presented the abstract, J.O.L., M.H.V., M.A.E.d.v.d.S. and A.J.C.R. wrote the abstract and analyzed the data. All authors collaborated in the project and were involved in funding acquisition. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: Ethical and legal advice was obtained from the HAS University of Applied Sciences, Den Bosch, The Netherlands (protocol code P2021 17, 16 December 2021). It was judged not to fall within the remit of the Medical Research Involving Human Subjects Act (WMO) and ethical clearance was provided by the review board. The study was conducted in accordance with the Declaration of Helsinki. All participants were informed to consult their general practitioner and/or a dietician in case of a high chance of a low protein intake and received a flyer from the Dutch Malnutrition Steering Group with additional information.

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Dietary Assessment of Plant Food Intake Using Multi-Biomarker Panels [†]

Victor Schmalte ^{*}, Julia Renz, Stephanie Seifert, Selina Busch, Benedikt Merz ^{ORCID}, Achim Bub ^{ORCID} and Manuela J. Rist ^{ORCID}



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Abstract: This abstract introduces the ongoing project “PlantIntake” and the accompanying validation study that will start in January 2024—current status and goals will be presented at the conference. PlantIntake, a JPI-funded project, aims to improve dietary assessment of plant foods, which currently relies on self-reported intake data that are prone to bias. High levels of plant foods in the diet are generally considered healthful, but there are also plant foods that are detrimental to health. Plant-based diet indices (PDIs), developed in the United States, have improved the understanding of the associations between plant food intake and health/disease outcomes. Within PlantIntake, European PDIs will be derived to suit European dietary habits and will include aspects of

variety and processing. For dietary assessment, objective measurements are desired and may be achieved with biomarkers of food intake or respective panels of them. Such multi-biomarker panels (MBMPs) are an approach to overcome the limitations of single biomarkers to obtain a more robust dietary assessment. This approach is in line with the trend in epidemiology to look at dietary patterns rather than individual foods. An inventory of putative biomarkers of plant food intake was compiled as a basis for the development of a wide-coverage targeted metabolomics method for the analysis of blood and urine samples. By applying this metabolomics method to samples from European dietary studies available within the consortium, MBMPs reflecting plant food intake and adherence to European PDIs will be developed and subsequently validated in a controlled intervention study. In a 2-week intervention period, 60 participants will be randomized into four groups. Three of these groups will receive a diet low, medium, and high in healthful plant foods, while the fourth group will receive a diet high in unhealthful plant foods. The derived MBMPs will be validated for their reliability in assessing the quantity and quality of plant food intake. In addition, the effect of confounders (e.g., age and sex), as well as dose- and time-response aspects on biomarker concentrations, will be investigated.

Keywords: biomarkers of food intake; plant foods; dietary assessment; multi-biomarker panels

Author Contributions: All authors contribute to the respective working package of the PlantIntake project and were involved in planning the intervention study. Conceptualization, all authors; project administration, M.J.R.; funding acquisition, S.S., B.M., A.B. and M.J.R. All authors have read and agreed to the published version of the manuscript.

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In Silico 3D/4D QSAR Prediction of 5-O-Caffeoylquinic Acid, Cyanidin-3-O-Galactoside Chloride and L-Epicatechin Anti-Inflammatory Activity, Cytotoxicity and Metabolism [†]

Yoana Kiselova-Kaneva ^{1,*} , Irina Potoroko ² and Diana Ivanova ¹ 



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Abstract: Background and objectives: *Sambucus ebulus* (SE) fruits are applied in folk medicine for the treatment of inflammatory gastrointestinal disorders and for immune stimulation in the autumn–winter period. LS-MS analysis has revealed that 5-O-Caffeoylquinic acid (Compound **1**, **C1**), Cyanidin-3-O-Galactoside chloride (Compound **2**, **C2**) and L-Epicatechin (Compound **3**, **C3**) are among the most abundant polyphenolic compounds in SE fruit extracts. The aim of the present study was to perform in silico 3D/4D QSAR prediction of their anti-inflammatory properties, metabolism, and cytotoxicity. Methods: Prediction was performed using molecular exterior- and molecular interior-based 3D/4D QSAR analysis with CiS/MC and AlteQ platforms. Calculated probability ranged from 0 (no probability) to 1 (high probability). Results: Anti-inflammatory testing predicted a very high probability to reduce carrageenan-induced paw edema in rats (0.96, 50–60% inhibition of inflammation) for **C3**; intermediate COX2 inhibition for **C2** (0.770, 11–19% inhibition), **C1**, (0.682, 7–10% inhibition) and **C3** (0.500, 2–7% inhibition); low inhibition of COX1 for **C2** (0.370), **C3** (0.355), and **C1** (0.206); low inhibition of LOX-5 for **C2** (0.376) and low anti-peritoneal activity for **C2** (0.345), **C1** (0.339), and **C3** (0.307). Cytotoxicity testing predicted low activity for **C2** (0.122) and **C3** (0.271), and **C1** (0.305). Metabolism modelling revealed high probability of the biotransformation of **C1** (0.904, 4 metabolites) and **C3** (0.817, 3 metabolites) and low probability of the biotransformation of **C2** (0.347) by CYP3A4. It also revealed high probability of biotransformation of **C2** (0.869, 4 metabolites) and low probability of **C3** (0.500) by CYP2D6. Discussion: 3D/4D QSAR in silico modelling appears to be a fast method for screening the possible biological properties of polyphenolic compounds. The method could be of interest in screening for new biologically active compounds for application in different industries, including in nutrition, pharmaceuticals, cosmetics, etc.

Keywords: *Sambucus ebulus*; polyphenols; in silico; QSAR

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Glycaemic Matrix and Segmentation: A New Metabolic Visualisation and Analysis Tool [†]

Nere Arroniz ^{*} , Alberto Conde Mellado and Leire Francés



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systemic background of multidimensional diseases and allow for a personalised approach. Continuous glucose monitoring (CGM) sensors and their broad use have been key in the discovery of the metabolic heterogeneity surrounding many disorders such as diabetes type II, and have placed the scientific community a step closer to determining which factors contribute to their complications and evolution. However, gathering data extending beyond glucose levels linked to lifestyle factors, such as nutrition, physical activity, sleep quality, and stress, poses a significant challenge in terms of representation, considering the substantial amount of data involved. To comprehend the relationship between these variables in a practical manner that empowers individuals to make choices enhancing their quality of life, there is a need for new graphics. These graphics would enable the observation of the overall framework in a contextualised manner and assist in establishing clear visual goals. **Methods:** This article introduces glycaemic matrix and metabolic segmentation, a new method for representing and evaluating functional profiles by combining glucose and lifestyle data. **Results:** In this early-phase trial, the potential of this approach to represent the complete glycaemic spectrum within its context and adapt to a diverse range of objectives is demonstrated. **Discussion:** We propose a promising tool to finally be able to cluster metabolic types through artificial intelligence (AI) and adapt clinical interventions to metabolic heterogeneity. This research is private research conducted under Glucovibes company R&D initiatives.

Keywords: CGM; metabolic heterogeneity; early-phase trial; artificial intelligence

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Postprandial Composite Biomarkers of Low-Grade Inflammation to Evaluate Nutritional Intervention Effects [†]

Suzan Wopereis * , Willem J. van den Brink , Tim J. van den Broek, Wilrike J. Pasman  and Femke P.

M. Hoevenaars



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Low-grade inflammation, a hallmark of metabolic disorders, originates in tissues as a consequence of metabolic dysfunction before it progresses to systemic manifestation. The early detection of low-grade inflammation in blood, therefore, is difficult. Here, we set out to develop a postprandial composite biomarker as an early indicator of low-grade inflammation to evaluate the effects of nutritional interventions. Methods: A postprandial composite biomarker was constructed with elastic net regression based on four blood cytokine responses to a mixed-meal challenge test in human reference groups ('healthy': 20–29 years, BMI < 25 kg/m²; 'compromised': 50–59 years, BMI > 25 kg/m²). The biomarker response was evaluated in three RCT studies with overweight adults and included two studies focusing on energy restriction (ER) and a whole-grain wheat intervention. In one ER study, an extended postprandial composite biomarker was constructed based on a total of twelve inflammatory and vascular markers. Results: A postprandial composite biomarker based on four blood cytokine responses to the mixed-meal challenge test could discriminate between the 'healthy' and 'compromised' reference groups. The whole-grain wheat intervention showed a significant reduction in the postprandial composite biomarker. No effects of caloric restriction, irrespective of quality of the diet, were observed on the biomarker. The extended postprandial composite biomarker reduced significantly in the persons within the 20% ER intervention group and did not change in the persons in the weight maintenance arm. The reduction correlated with body fat distribution, in particular, the ratio between subcutaneous and internal fat depots. Discussion: Composite biomarkers based on postprandial blood-based cytokine levels are well capable of discriminating low-grade inflammation between 'compromised' and 'healthy' metabolic phenotypes, which was not possible using fasting blood-based cytokine levels. Although the ability of the four-cytokine-based postprandial composite biomarker of low-grade inflammation to capture the effects of caloric restriction was limited, this biomarker could show the effects of a whole-grain wheat intervention. While whole-grain wheat reduced the secretion of cytokine mediators, an extended version of the composite biomarker indicated that 20% ER only reduced vascular inflammation, suggesting different underlying mechanisms.

Keywords: low-grade inflammation; composite biomarker; mixed-meal challenge test; postprandial; nutritional interventions

Author Contributions: Conceptualization, S.W., F.P.M.H., W.J.P.; methodology, W.J.v.d.B., T.J.v.d.B., formal analysis, T.J.v.d.B.; writing—original draft preparation, S.W.; writing—review and editing, all authors. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data described in the manuscript can be made available upon request to the corresponding author.

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Utilisation of Technological Tools for Weight Management by Maltese Nutrition and Dietetic Professionals [†]

Hollie Zammit *  and Claire Copperstone



Citation: Zammit, H.; Copperstone, C. Utilisation of Technological Tools for Weight Management by Maltese Nutrition and Dietetic Professionals. *Proceedings* **2023**, *91*, 138. <https://doi.org/10.3390/proceedings2023091138>

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[†] Presented at the 14th European
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Abstract: Background and objectives: The high obesity prevalence remains a significant global and local health concern. Digital technologies, including electronic health (e-health) and mobile health (m-health), are being increasingly utilised to prevent and address people's excess weight. Nutrition professionals' experiences with digital tools in local practices is a relatively unresearched area. The aim of this small study was to explore the utilisation of e-health and m-health by locally registered nutrition and dietetic professionals for weight prevention and management. Methods: An adapted, anonymised questionnaire was disseminated via social media between November 2021 and January 2022 following ethical approval. Twenty-four questions—(twenty-three close-ended and one open-ended) were included and covered: demographics, the challenges experienced and their personal attitudes on e-health and m-health. The data were statistically analysed using SPSS (IBM, version 23), where descriptive statistics and chi-squared tests were utilised. Results: The sample respondents (n = 20) were mainly female (85.0%, n = 17), with half in the 25–34 age category (50.0%, n = 10). A total of 90.0% (n = 18) used technologies in practice, with e-health technologies being preferred. Novel technologies were mainly used for informational or educational purposes (95.0%, n = 19) and to communicate with clients (85.0%, n = 17). Video conferencing (89.5%, n = 17) and educational websites (84.2%, n = 16) were the most popular tools. A total of 90.0% (n = 18) believed that these technologies could support weight management through behaviour change support (100.0%, n = 20) or provide updated information on healthy and sustainable eating (95.0%, n = 19). A total of 95.0% (n = 19) wanted to receive training/further training in digital technologies. The main personal challenge experienced was a difficulty in utilising these technologies (65.0%, n = 13). The main reasons for using digital health were to improve their clients' nutrition knowledge (85.0%, n = 17) and engagement with the self-management of weight and for overall health (80.0%, n = 16). Discussion: The results of this small study suggest an overall interest, but with further training needs. More research on e-health and m-health is recommended as part of an overall strategy to reduce the obesity prevalence in Malta.

Keywords: obesity management; digital tools; Malta

Author Contributions: Conceptualization, C.C.; methodology, C.C and H.Z.; data curation; H.Z.; formal analysis, H.Z; writing—original draft preparation, H.Z.; writing—review and editing, C.C.; All authors have read and agreed to the published version of the manuscript.

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The Development of an Electrical Pulse Stimulation System for Examining In Vitro Models of Exercise [†]

Grzegorz Nikrandt * , Anna Radziejewska and Agata Chmurzynska 



Citation: Nikrandt, G.; Radziejewska, A.; Chmurzynska, A. The Development of an Electrical Pulse Stimulation System for Examining In Vitro Models of Exercise. *Proceedings* 2023, 91, 134. <https://doi.org/10.3390/proceedings2023091134>

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stimulation (EPS) is widely used to investigate the mechanisms behind the beneficial effects of physical activity in in vitro studies. The aim of our study was to develop a cheap, stable EPS system and protocol capable of causing C2C12 mouse myoblasts cells to contract. Method: The EPS system consists of a control unit, a WEP PS305D power supply unit, and a FY6800 signal generator. The control unit is a circuit board developed by us that connects the power supply unit with the signal generator. The control unit consists of two pairs of electrodes that can be connected to a six-well plate equipped with a manually mounted platinum wire. The stability of the system was evaluated using a Hantek 6022BE oscilloscope to measure ninety minutes of electrical pulse stimulation of C2C12 mouse myotubes. A protocol was established for cell culture and EPS parameters. The contraction of the myotubes was confirmed under a Leica DMi1 inverted microscope. Results: Our custom system is very accurate and has a wide range of EPS parameter adjustment options. The results show that the system is stable over ninety minutes of EPS with variable parameters. The EPS protocol was also optimized. Discussion: To date, only a few custom EPS systems have been described. Our system is relatively cheap, easy to build, and stable, and so could serve as an alternative to commercially available systems.

Keywords: electrical pulse stimulation; myotubes; cell culture; protocol

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Abstract: Background and objectives: Electrical pulse

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Cancer Risk Reduction by Dietary Guideline Adherence: A Prioritization Approach with a Web App [†]

Ruidong Zhang ^{1,2,*}, Pricivel Carrera ¹, Odile Elias ^{1,2}, Tobias Norajitra ², Angela Goncalves ^{1,3}

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and Objectives: Diet is an important modifiable cancer risk factor. Studies show that adherence to dietary guidelines reduces cancer risk and that adherence is affected by the complexity of dietary actions and the awareness of their effect. Intervention on complex nutrition issues requires clear nutrition messages to the public. To improve adherence for cancer prevention purposes, this research describes a method to provide tailored dietary recommendations by prioritizing dietary advice from the guideline, based on diet–disease relationships revealed by disease risk models. In addition, we developed the method as a risk calculator framework to provide the interoperability between risk models and guidelines. The framework is integrated into our cancer prevention app to facilitate risk communication and guideline adherence. Methods: We propose a simple and intuitive method to define and align cancer risk models and dietary guidelines using object-oriented programming paradigms, which can encapsulate the relationship between dietary advice, cancer risk, and lifestyle variables. The effect of each action can be simulated by applying modified dietary variables into the probability model to calculate an expected risk change. An interactive intervention is then designed to enhance understanding and promote the adoption of dietary actions. It consists of three steps: selecting dietary actions ranked by their preventive effect on cancer risk, modifying selected variables to desired values, and visualizing the simulated changes in cancer risk with dietary actions by humanoid pictogram. Results: We demonstrate the mapping of actions to the corresponding variables for a chosen cancer risk prediction model while ranking them according to their preventive effect. We further show that our method can easily be adapted to any dietary guideline. We implemented more than 10 cancer risk models covering common cancer types and integrated them into the system. Moreover, it is simple to add other cancer risk models to support the prevention of additional cancer types. As a key feature of a web-based application, the practical use of the method allows for the delivery of personalized action suggestions and notifications based on the user’s lifestyle factors. An usability testing was carried out between August and October 2023 with 9 participants using the guideline made by German Nutrition Society (DGE). The test proved the intervention’s effectiveness. Discussion: On the frontier of nutrition science and preventive medicine, our work is the first approach that combines risk models and dietary guidelines into a comprehensive digital health intervention system. It informs the user about the most



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impactful dietary behaviors, promotes adherence to dietary guidelines, and, accordingly, facilitates cancer risk reduction.

Keywords: dietary guideline; risk model; cancer; simulation; data integration; epidemiology; prevention; digital intervention

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The Development of a Nutrient Database to Analyse the Dietary Intake of Older Indians in the Longitudinal Aging Study in India—Diagnostic Assessment of Dementia (LASI-DAD) [†]

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Abstract: Investigating diet-related disease in India's ageing population is challenging due to poor dietary assessment infrastructure and limited capacity for nutritional analyses. We developed a semi-quantitative Food Frequency Questionnaire (FFQ) to capture dietary intake among older Indian adults. Nutrient analysis of FFQ data requires linkage to a nutrient database preferably based on local food composition. However, the Indian Food Composition Tables (IFCT) provided only partial coverage for FFQ items, nutrient data for cooked foods were unavailable, and some important nutrients were missing, e.g., iodine and vitamin B12. The objective was to develop a nutrient database maximising the IFCT to allow for the analysis of FFQ data. The development of the nutrient database involved: (1) the creation of a core dataset within the Nutritics (2019) software platform comprising analytical data for matched foods in the IFCT reference database; (2) the selection of suitable matches for additional foods/beverages consumed in the FFQ informed by local dietetic expertise; (3) the import of nutrient profiles for additional foods/beverages from international food composition tables (UK, USA, and Singapore) to provide full coverage for all FFQ items; (4) the filling of nutrient data gaps in the core IFCT dataset to ensure all foods/beverages have a value for each nutrient; and (5) the generation of a conversion file for food frequencies to daily intakes (in servings and grams) to facilitate FFQ linkage with the nutrient database. The complete nutrient database provides full coverage of FFQ raw and cooked food/beverages and has the capability to analyse 53 nutrients. Overall, 53% of the FFQ items were matched to the IFCT, whilst 28% were matched from the UK (GB21-0), 15% from the USA (FNDDS), and 4% from the Singapore food tables. All FFQ items matched to the IFCT had missing nutrients mapped from matches in other databases, with GB21-0 being the first preference. For cooked FFQ items matched to the IFCT (n = 21), an appropriate cooking method was applied using established nutrient retention factors. The bespoke nutrient database developed through the integration of nutritional expertise and dietary assessment software will allow for the nutrient analysis of FFQ data. The next step is to automate the nutrient analysis process from computer-assisted FFQ data collection in Wave 2 of LASI-DAD.

Keywords: diet; dietary intake; nutrient database; nutritional analysis; older adults; India



Citation: Logan, D.; Dey, AB.; Chutani, A.M.; Banerjee, J.; Khobragade, P.; Lee, J.; McEvoy, C. The Development of a Nutrient Database to Analyse the Dietary Intake of Older Indians in the Longitudinal Aging Study in India—Diagnostic Assessment of Dementia (LASI-DAD). *Proceedings* **2023**, *91*, 70. <https://doi.org/10.3390/proceedings2023091070>

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Abstract

Plasma Proteomic Profiles of White British and British Indian Vegetarians and Non-Vegetarians in the UK Biobank [†]

Tammy Y. N. Tong * , Karl Smith-Byrne, Keren Papier , Joshua R. Atkins, Timothy J. Key and Ruth C. Travis



British and British Indian Vegetarians and Non-Vegetarians in the UK Biobank. *Proceedings* **2023**, *91*, 110. <https://doi.org/10.3390/proceedings2023091110>

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Belgrade, Serbia, 14–17 November
2023.

Abstract: Background and
objectives: Proteins have an
integral role in almost all
biological processes and may be
influenced by environmental
factors, such as diet. We aimed
to assess differences in

circulating proteins between people of different habitual dietary groups, which may provide novel information in understanding biological functions and disease aetiology. **Methods:** The UK Biobank recruited adults aged 40 to 69 years throughout the UK in 2006–2010. The relative concentrations of 1463 plasma proteins were quantified using Olink Proximity Extension Assay on samples from ~54,000 participants. Participants were also asked to report their ethnicity and consumption of red and processed meat, poultry, fish, dairy and eggs. From this information, we identified six diet groups among the white British participants (23,116 regular meat eaters, 23,323 low meat eaters, 484 poultry eaters, 1074 fish eaters, 722 vegetarians, and 54 vegans), and two diet groups among the British Indian participants (390 meat eaters and 163 vegetarians). We used multivariable-adjusted linear regressions to assess differences in protein concentrations by diet groups. **Results:** We observed significant differences in many plasma proteins ($p < 0.00008$ after correction for multiple testing, 683 proteins in white British participants), with many proteins showing a gradient effect in magnitude of differences across diet groups. Of the biggest differences, compared with white British regular meat eaters, the other white British diet groups had higher concentrations of FGF21 (e.g., +0.40 units in vegetarians on a standardised scale), GUCA2A (+0.33), FOLR1 (+0.32), IGFBP2 (+0.31), FGF23 (+0.31) and DSG2 (+0.30), but lower concentrations of HAVCR1 (-0.38), CDHR2 (-0.26) and ACP5 (-0.24); concentrations of CD99L2 were lower in low meat, poultry and fish eaters (-0.16), but higher in vegetarians (+0.24). The observed differences were generally similar in direction for the white British and British Indian participants. The proteins identified are involved in a range of different biological processes, particularly in gastrointestinal tract function, as well as kidney, liver and muscle functions, and cell growth and cell adhesion, among other processes. **Discussion:** The substantial differences in plasma proteomic profiles between people of different diet groups indicate differences in cellular activities and may relate to differences in future disease risk.

Keywords: vegetarians; vegans; proteomics

Author Contributions: Conceptualization, T.Y.N.T., T.J.K. and R.C.T.; methodology, T.Y.N.T., K.S.-B., T.J.K. and R.C.T.; formal analysis, T.Y.N.T.; investigation, T.Y.N.T.; data curation, K.S.-B.; writing—original draft preparation, T.Y.N.T.; writing—review and editing, T.Y.N.T., K.S.-B., K.P., J.R.A., T.J.K. and R.C.T.; funding acquisition, T.Y.N.T., T.J.K. and R.C.T. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: All participants gave informed consent to participate using a signature capture device at the baseline visit.

Data Availability Statement: This research has been conducted using UK Biobank Resource under application 67506. Bona fide researchers can apply to use the UK Biobank data set by registering and applying at <http://ukbiobank.ac.uk/register-apply/>.

Conflicts of Interest: The authors had no conflict of interest.

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Validation of an In Vitro Fermentation Model of Colonic Gas Production [†]

Catriona L. Thomson, Ada L. Garcia and Christine A. Edwards *



Citation: Thomson, C.L.; Garcia, A.L.; Edwards, C.A. Validation of an In Vitro Fermentation Model of Colonic Gas Production. *Proceedings* **2023**, *91*, 65. <https://doi.org/10.3390/proceedings2023091065>

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Abstract: Background: The rapid production of gas during the colonic fermentation of highly

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soluble fermentable fibres may cause unpleasant gastrointestinal symptoms. In vivo feeding studies are often used to assess symptomatic response to fibres; however, in vitro fermentation studies are quicker, cheaper, and more reproducible. The aim of this study was to validate an in vitro colonic fermentation model of gas production against in vivo experiences of symptoms following inulin consumption. Methods: Healthy volunteers (n = 21, 18–65 y/o, M/F) provided a stool sample used to inoculate an in vitro colonic fermentation model. Fermentation bottles containing faecal slurry, a fermentation medium, and a fibre substrate (inulin) were incubated at 37 °C for 24 h in a shaking water bath. The total gas production (mL) over 24 h (minus control) was measured. Each stool donor added 15 g inulin to a low-fibre diet and recorded experiences of gastrointestinal symptoms for 48h. In vitro gas production and in vivo symptom experience were compared for each donor following tertile classification. Low in vitro gas production was classed as <45mL (<1st quartile of dataset), medium as 45–78 mL (1st quartile–3rd quartile), and high as >78 mL (>3rd quartile). In vivo symptom response was classed as low if symptoms were mild and/or short-lived (<1 h duration); medium if moderate and/or prolonged (1 h); and high when abdominal pain or multiple prolonged (3 h) symptoms occurred. Results: In vitro gas production was high in six cases (29%); medium in ten (48%); and low in five (24%). Symptom experience was high in seven cases (33%); medium in five (24%); and low in nine (43%). The same classification occurred in 57% of cases and classification into adjacent categories occurred in 43%; no complete misclassification occurred. Agreement between the methods was fair: weighted kappa = 0.378 ($p < 0.01$). Discussion: The level of agreement between the in vitro model of gas production and in vivo symptom reports, and the absence of any cases of complete misclassification, is promising. This simple in vitro batch-fermentation model may be used in future to screen fibres for their potential impact on gastrointestinal symptoms. This will help develop strategies to increase fibre consumption generally and optimise their use in food reformulation.

Keywords: dietary fibre; in vitro fermentation; gastrointestinal symptoms

Author Contributions: C.L.T., A.L.G. and C.A.E. designed the study and wrote the manuscript, C.L.T. conducted the study and statistical analysis. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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A Step-by-Step Harmonization Process for Nutritional Epidemiology Purposes: A Methodological Work of the Collaborative PROMED-COG Pooled Cohorts Study [†]

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Abstract: Background and objectives: Pooling datasets for nutritional epidemiological purposes are becoming more common because of their several advantages. Here, we described our step-by-step dietary data harmonization process applied within the PROMED-COG pooled cohorts study aiming to evaluate the effect of nutrition on neurocognitive ageing. Methods: This is a collaborative project that includes data from four Italian population studies recruited during the 1992–2023 period: BEST; Pro.V.A.; ILSA; and NutBrain. Retrospective nutritional data harmonization was performed considering three main nutritional exposures such as body composition (weight and circumference), undernutrition (by combining phenotypic and etiologic criteria), and dietary habits (through food frequency questionnaires). In particular, the challenge was the harmonization procedure for dietary habits that required several steps: (i) access to documentation from the original studies, (ii) discussion with the researchers responsible for each dataset; (iii) exploration of each dataset before the final harmonization; (iv) agreement on portion size and food frequency standardization, and food classification for healthy dietary pattern computation; (v) name, definition, and categorization of the harmonized common variable and the original variables, for each study; (vi) development and application of the algorithm to obtain the harmonized variables from the original ones; and (vii) final pooled dataset preparation. Results: The pooled sample included 9326 adults aged 40–101 years, of which 52% were women. The main issues encountered were due to the heterogeneity of dietary assessment methods across studies: type of instrument (unstructured dietary questionnaires for ILSA and Pro.V.A. vs. structured FFQ for the BEST and NutBrain); data collection time frame (1992–1997 in ILSA, Pro.V.A., and BEST and 2019–2023 in NutBrain); and the period used for diet reporting (last week for ILSA and Pro.V.A., last 12 months for BEST and NutBrain). On the other hand, there were similar characteristics regarding the administration method of data collection (by trained interviewers), comparability of the food composition database used for nutrient profiling, community-dwelling setting, and geographical area (Italy), fostering the comparison across studies. Conclusion: the pooled dataset represents a harmonization standard procedure that may be useful to advance future epidemiologic research with different applications and, specifically within the PROMED-COG, to draw valid and solid conclusions about the nutrition–neurocognitive ageing relation in the general population.



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Keywords: retrospective data harmonisation; pooled datasets; dietary data; observational studies; population-based studies

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writing—original draft preparation, F.P.; writing—review and editing, S.C., C.T., C.T.M., S.M., G.S. and M.N.; funding acquisition, all authors. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study protocols were implemented in compliance with the guidelines outlined in the Declaration of Helsinki. The responsible Ethics Committees approved all procedures; for the ILSA study, it was approved by the institutional review board of the eight participating municipalities; while for the Pro.V.A. study, it was approved by the local Ethics Committee. The BEST-FU study was approved by the Ethics Review Board of the CNR of Segrate (MI); and the NutBrain study was approved by the Medical Ethics Committee of Pavia.

Informed Consent Statement: For original studies conducted by ILSA and Pro.V.A., written informed consent was obtained from all participants. For the BEST-FU study, verbal informed consent was witnessed and formally recorded by all participants. In the case of the NutBrain study, all participants provided formal written informed consent.

Data Availability Statement: Data are available under request.

Conflicts of Interest: The authors declare no conflict of interest.

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A Comparison of Different Methods for Meal Pattern Analysis [†]

Cathal O’Hara * and Eileen R. Gibney



Switzerland.

Citation: O’Hara, C.; Gibney, E.R. A Comparison of Different Methods for Meal Pattern Analysis. *Proceedings* **2023**, *91*, 54. <https://doi.org/10.3390/proceedings2023091054>

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Abstract: Research on meal patterns, including both combinations of foods and meals, has increased in recent years. Advanced statistical techniques are required to identify these patterns. Despite this, no study has assessed whether applying different statistical approaches to the same data gives rise to different outcomes. The objective was to identify meal patterns using different methods and compare the resulting meal patterns



that were identified. This study is a secondary analysis of data from NHANES 2017–2018. A small number of generic meals were identified that were representative of the larger number of actual meals consumed with regard to their food group and nutrient content, using a previously established method. Combinations of these generic meals consumed (meal patterns) were identified using three different statistical approaches: partitioning around the medoids clustering, principal component analysis (PCA), and latent class analysis (LCA). For clustering and PCA the input data were the % total energy intake from each of the generic meals and five binary variables indicating consumption or non-consumption of five meal types (breakfast, lunch, dinner, snacks, and beverages). For LCA the input data were five categorical variables for each of the five meal types giving the specific

generic meal consumed at each meal type and five binary variables that were the same as those used in clustering and PCA. The number of meal patterns identified were 26 by clustering, 18 by PCA, and 17 by LCA. Meal patterns in which individuals skipped certain meal types were only observed using clustering and LCA, but not PCA. There was only one meal pattern that was identical between when comparing clustering patterns with LCA patterns, i.e., the generic meals consumed at all five meal types were the same. No other identical patterns were identified. For all comparisons (clustering v. PCA, clustering v. LCA, and PCA v. LCA), there were two meal patterns in each in which identical generic meals were consumed in four of the five meal types. Different approaches to meal pattern analysis gave rise to the differing number of meal patterns; similar identification of meal skipping between clustering and LCA, but not PCA; and differences in the content of the meal patterns. Caution is required when comparing meal patterns identified using differing statistical approaches.

Keywords: meal patterns; eating behaviours; eating occasions; clustering; latent class analysis; principal component analysis

Author Contributions: Conceptualization, C.O'H. and E.R.G.; methodology, C.O'H. and E.R.G.; formal analysis, C.O'H. and E.R.G.; resources, E.R.G.; data curation, C.O'H.; writing—original draft preparation, C.O'H.; writing—reviewing and editing, C.O'H. and E.R.G.; supervision, E.R.G.; project administration, C.O'H. and E.R.G.; funding acquisition, E.R.G. All authors have read and agreed to the published version of the manuscript.

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Health App Use May Motivate the Maintenance of Physical Activity during Pregnancy [†]

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Abstract: Background and objectives: A health-promoting lifestyle during pregnancy is beneficial for both the mother and the child, but an increase in physical activity, eating a healthy diet and achieving the recommended weight gain require high motivation. Health apps may serve as efficient tools for supporting a health-promoting lifestyle during pregnancy. Although the market for health apps is thriving, the scientific validity of these apps has rarely been studied. The objective of this study was to characterise health app use among pregnant women and to investigate whether the frequency of health app use leads to a change in gestational weight, diet quality and physical activity. Methods: Pregnant women were recruited through social media announcements. Participants were asked to record their lifestyle habits in a health app from early pregnancy to delivery. Online questionnaires were used to assess their diet quality and physical activity with validated indices and self-reported weight in early (<28 gestational weeks) and late (34–36 gestational weeks) pregnancy. Physical activity was categorised into light (<5 MET h/wk), moderate (5–30 MET h/wk) and high physical activity (>30 MET h/wk). Results: Altogether, 1038 participants were enrolled in the study. Of them, 37% (386/1038) used the app at least once, whilst 63% did not use the app. The median (IQR) duration of app use was 4.7 (1.1–15.6) weeks and the median (IQR) number of recordings was 59 (19–294). App users were categorised as frequent (use ≥ 4.7 weeks, 19%) and occasional app users (<4.7 weeks, 19%). No differences were seen between the groups with regard to their change in weight or diet quality score. The proportion of women with a moderate or high activity level decreased in all groups, but this was less in frequent (OR 0.61, 95% CI 0.40–0.94, $p = 0.025$) and occasional app users (OR 0.55, 95% CI 0.32–0.97, $p = 0.04$) compared to non-users (time × group interaction, $p = 0.036$). Discussion: The results demonstrate extensive variations in app use, but the benefits of app use may arise from the maintenance of physical activity. This intervention into the typically observed decrease in physical activity over the course of pregnancy may lower the risk of pregnancy complications, including gestational diabetes.

Keywords: gestation; smartphone; health app; gestational weight; diet quality; physical activity

Author Contributions: Conceptualization, K.L.; methodology, E.K. and K.L.; formal analysis, H.O., E.L. and E.K.; investigation, E.K.; resources, K.L.; data curation, E.K.; writing—original draft preparation, E.K.; writing—review and editing, E.K., K.L., M.M.R., H.O. and E.L.; supervision, K.L.; project administration, K.L.; funding acquisition, K.L. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of University of Turku, Finland (statement 62/2016, on 12 December 2016).



Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available upon reasonable request from the last author (K.L.). The data are not publicly available as they contain information that could compromise the privacy of the research participants.

Conflicts of Interest: The authors declare no conflict of interest.

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Avenanthramides, Avenacosides, and β -Glucans in Oat-Based Milk Alternatives—How Oat's Nutritional Compounds Are Being Affected by Various Stages of Processing [†]

Roisin McCarron ^{1,*}, Lisa Methven ¹, Stephanie Grahl ², Ruan Elliott ³ and Stella Lignou ¹



Belgrade, Serbia, 14–17 November 2023.

Citation: McCarron, R.; Methven, L.; Grahl, S.; Elliott, R.; Lignou, S. Avenanthramides, Avenacosides, and β -Glucans in Oat-Based Milk Alternatives—How Oat's Nutritional Compounds Are Being Affected by Various Stages of Processing. *Proceedings* **2024**, *91*, 423. <https://doi.org/10.3390/proceedings2023091423>

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Abstract: Background: Oat-based Milk Alternatives (OMAs) provide multiple health benefits arising from oat's unique compounds: avenanthramides, avenacosides, and dietary fibre β -glucan. Avenanthramides—polyphenols, unique to oats, provide anti-inflammatory and antioxidant effects, whilst avenacosides are saponins with anti-bacterial and anti-fungal properties. β -Glucans assist in lowering blood cholesterol and lead to the prevention of diabetes and cardiovascular diseases. However, oats undergo many stages of processing to ensure a sensory appealing and safe OMA product, including enzymatic treatment, heating, high shear, decanting of larger solids, and homogenisation. It is possible that throughout these stages, compounds may be affected by degradation or lost entirely. Objective: The concentration of avenanthramides, avenacosides, and β -glucans in the OMA samples was measured at each of the 12 stages of an OMA production, with a comparison of short ultra-heat treatment (UHT) and prolonged high heat treatment, to assess how they may be affected. Design: OMA samples were produced from basic ingredients within the pilot plant. Liquid chromatography—mass spectrometry was used to measure the concentration of avenanthramides and avenacosides. β -Glucan was determined spectrophotometrically using the Megazymes assay. Results: Avenanthramides and avenacosides were found to significantly increase in concentration after initial enzymatic treatment with alpha-amylase, whilst avenanthramides also increased post 90 °C treatment, and decanting – suggesting that these compounds are not being lost in the removed solids. However, avenanthramides decreased after UHT and prolonged heat treatment, suggesting they may be susceptible to degradation from prolonged heat and temperatures above 120 °C. β -Glucans concentrations decreased post glucoamylase treatment, and decanting – suggesting that β -glucans are lost within the decanted slurry, and increased after treatment with alpha-amylase, 90 °C and high shear mixing. Conclusion: With this information, future products may be optimised to preserve these components to improve the health benefits of oat-based milk alternatives.

Keywords: Oats; avenanthramide; β -glucan; Avenacosides; processing

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Author Contributions: R.M., S.L., L.M., R.E. and S.G. contributed to conception and design of the study. R.M. wrote the first draft of the manuscript. S.L. assisted with statistical analyses, whilst L.M. and S.L. assisted with laboratory analyses and results interpretation. All authors contributed to manuscript revision, read, and approved the submitted version. All authors have read and agreed to the published version of the manuscript.

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Short-Term Effects of Fruit Juice Enriched with Vitamin D3, n-3 PUFA, and Probiotics on Subjective Appetite and Blood Pressure: A Randomized Controlled Clinical Trial in Healthy Adults [†]

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Abstract: Introduction: Mixed fruit juices (FJ) may have several benefits on subjective appetite. They may curb hunger and provide sustained energy throughout the day. This study aimed to determine the effects of consuming a mixed commercial FJ (apple, orange, grape, pomegranate; FJ-control) and the same FJ fortified either with 2 probiotics strains (108 cfu/mL *Lactocaseibacillus casei* Shirota and *Lactocaseibacillus rhamnosus* GG), 50 µg vitamin D3, 8.33 g n-3 polyunsaturated fatty acids, or with the combination of all of these biofunctional ingredients (vitamin-D3-n-3-probiotics), on subjective appetite and blood pressure (BP). Methods: Clinically healthy volunteers participated in this randomized, double-blind, crossover, controlled trial. In total, 11 healthy and normotensive volunteers (25 ± 2 years; 6 males; BMI = 23 ± 1 kg/m²) were randomly assigned to receive the 5 types of FJs, all containing 50 g available carbohydrates. Participants rated their hunger, desire to eat, perceived fullness, thirst, preoccupation with food, and pleasure of eating on visual analog scales (VAS) at baseline and up to 180 min after consumption of each test FJ. BP was measured at the beginning and end of each drink test session. Results: The FJ with vitamin-D3 significantly increased hunger compared with the FJ-control. The FJ with vitamin-D3 significantly increased desire for food compared to the FJ with n-3, FJ combination, and FJ-control. The FJ with n-3 significantly increased fullness compared to the FJ with vitamin-D3 and the FJ with probiotics. The FJ with vitamin D3 significantly increased thirst compared to the FJ combination, n-3, probiotics, and FJ-control. All FJs were pleasurable. The FJ with vitamin-D3 and n-3 significantly increased systolic BP compared to the other FJs, without differences between the other FJs. The FJ with vitamin-D3 significantly increased diastolic BP, without differences between the other FJs. Discussion: FJs affected subjective satiety and BP acutely. Consumption of the FJ with vitamin-D3 increased systolic and diastolic BP, hunger, desire to eat, and thirst acutely; whereas consumption of the FJ with n-3 increased systolic BP and fullness acutely. All these effects were observed when these biofunctional ingredients were consumed alone, but not when ingested in combination (FJ with vitamin-D3, n-3, and probiotics), which needs to be further investigated.

Keywords: fruit juice; vitamin D3; n-3 PUFA; probiotics; subjective appetite

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Author Contributions: E.P. conceptualized and designed the clinical trial and drafted the manuscript. E.P. and C.T. conceptualized the study including the enrichment of fruit juice with vitamin D3, n-3 PUFA, and probiotics. E.P. and C.T. were responsible for funding acquisition, served as supervisors to this project, and provided all resources. N.Z. conducted nutritional and statistical analyses and drafted the manuscript. N.Z., C.A., C.T. and D.-L.B. collected the data. S.V.-A. and O.P. created the probiotic cultures and encapsulated the probiotics into the fruit juice. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, approved by the Ethics Committee (EIDE) of the Agricultural University of Athens (EIDE Reference Number: 78 12-10-2022, and registered at [ClinicalTrials.gov](https://clinicaltrials.gov) (NCT05702359)).

Informed Consent Statement: Informed consent was obtained from all the participants involved in this study.

Data Availability Statement: Data are contained within the article.

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Abstract

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Abstract

ILSI Europe Prebiotic Task Force: Investigating the Potential of Prebiotics to Rebalance and Maintain Health [†]

Paul de Vos ^{1,*}, Naomi V. Venlet ², Elaine E. Vaughan ³ and Kristin Verbeke ⁴



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Abstract: The Prebiotic Task Force of the International Life Sciences Institute (ILSI) Europe advances the science and understanding of prebiotics and their health benefits. The Task Force, comprising academic advisors and numerous industry scientists, aims to provide scientific evidence to support the development of prebiotic-containing foods and dietary supplements that can improve gut health and overall wellbeing. Last



year, the Task Force published several (peer-reviewed) scientific papers: (1) a concise monograph, translated into seven languages, providing a user-friendly introduction to the abundant scientific knowledge on prebiotics, probiotics and the gut microbiota and their impact on human health; (2) a narrative review, providing an overview of the role of non-digestible carbohydrates in the human diet, their impact on the gut microbiota, and their potential as prebiotics, with a particular emphasis on structure-related activities and in vitro models; (3) a perspective review, describing state-of-the-art tools for harnessing the microbiome for

precision health, such as proand prebiotic dietary solutions amongst others, and a corresponding future vision of healthcare; and (4) perspectives on what we know, what we need to investigate, and how to put knowledge into practice in the microbiota-gut-brain axis. Currently, the role of prebiotics in bacterial and viral infections and vaccination efficiency is being systematically reviewed. The review will give the current status for prebiotics impact on infections, both prevention or recovery, and in supporting vaccination efficacy, for academics and industry scientists in this field. The Task Force will also commence activity on highlighting the need to perform studies in healthy participants that test the potential “rescuing” effects of prebiotics under conditions where cognition may be transiently compromised. In addition, a multi-stakeholder workshop to discuss evidence for microbiome modulation and physiological pathways for improved health and reduced disease risk, that may support a roadmap for future health claim substantiation, is being initiated this year.

Keywords: prebiotic; gut microbiota; health claims; immunity; cognition; microbiome; selective; bifidobacteria; short chain fatty acids; inulin

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Bioactives and Other Nutritional Components in the Jaggery Production Process [†]

Nisha Pujari, Nirali Dedhia, Sanjay Mahajani, Narendra Shah and Amit Arora *



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and a good source of minerals, essential vitamins and bioactives. Jaggery manufacturing is a continuous heat and mass transfer process which involves various unit operations and in which the effectiveness of juice clarification plays an important role in maintaining the nutritional quality and storage life of jaggery. The major components of nutritional interest in NCSs are minerals and bioactives and they are gaining worldwide attention due to their nutraceutical properties. Hence, there is a need to quantify the nutrients present in NCSs as well as assess their biological absorption and function. This work aims to study the potential flow of materials within a jaggery processing unit by combining sampling, analysis and quantification. Sugarcane juice, clarified juice, scum and jaggery were analyzed for their total sugars, total phenolic and flavonoid content, mineral content and antioxidant potential to clearly understand at which step of jaggery manufacturing nutritional losses take place, if at all. A profiling of phenolic and flavonoid compounds was conducted using liquid chromatography–mass spectroscopy. The total ash content in raw cane juice, scum and jaggery was found to be in the range of 0.1–0.4%, 1–3% and 1–2% (dry basis), respectively. It was found that almost half of the mineral contents from sugarcane juice were lost in scum ($p < 0.05$). All the mineral elements showed a similar affinity towards scum. However, through liquid chromatography–mass spectroscopy, it was seen that most of the polyphenols (75%) that positively influence human health, such as oryzarol, hydrocinnamic acids, gentisic acid, hydrobenzoic acids, etc., were retained in jaggery. The same could be validated when looking at the total phenolic and flavonoid contents of sugarcane juice, scum and jaggery along with their antioxidant potential. Some unreported phenolics and flavonoids, such as isoferulic acid, prunitrin and maritimetin, which are known to have anti-inflammatory properties, were detected in selected NCS samples. In order to retain maximum mineral content in jaggery and to ensure the removal of appropriate amounts of scum, technological upgrades must be studied and the clarification step must be optimized and standardized.

Keywords: jaggery; NCS; nutritional profile

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Abstract: Jaggery, a non-centrifugal sugar (NCS), is a naturally produced sweetener

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The Anti-Inflammatory Action of Artichoke, Fenugreek and Caigua (AFC) Original Blend in an Inflammatory Bowel Disease In Vitro Model [†]

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Abstract: Background and objectives: The incidence of chronic inflammatory pathologies has incrementally increased in recent years, as in the case of inflammatory bowel disease (IBD), which is characterized by intestinal epithelial barrier disruption, increased inflammatory mediator production and excessive tissue injury. Changes in eating habits might have played a key role in this scenario. Therefore, the interest in specific diet development and in functional food formulation has been growing. Phytoextracts from several origins, from plants to waste, enriched in bioactive molecules, alone or combined, might be a resource for the obtainment of an efficient synergistic beneficial. Thus, the aim of this study consists of evaluating the protective effects of artichoke, fenugreek and caigua (AFC) phytoextract original blend. Methods: In order to mimic the intestinal barrier's inflammatory environment, Caco-2 cells were cultured and polarized on a transwell system and then exposed to a pro-inflammatory cytokine cocktail (TNF α and IL-1 β). Before being exposed to an inflammatory stimulus, cells were pre-treated with an AFC digested blend, according to the INFOGEST in vitro static digestion protocol. After digestion, the content of active substances within the blended extract (ACFB) was revealed by UHPLC–ESI–HRMS analysis. The AFC digested extract's protective effect was evaluated by measuring the transepithelial resistance (TEER) as a marker of barrier integrity and analysing the nuclear factor kappa B (NF- κ B) pathway. Results: The TEER values improved in cells which were pre-treated with the AFC blend, relative to inflamed cells, suggesting a regulation in tight junction protein expression and/or localization. The transcription factor p65NF- κ B is activated by phosphorylation under cytokine exposure, with a 160% increase in its target COX-2. Moreover, a 40-fold increase in IL-8 release was observed. Interestingly, in cells pre-treated with the AFC blend, the activated p65NF- κ B was halved, compared to inflamed cells only. Furthermore, a consequent reduction by about 50% for COX-2 and by 30% for IL-8 was observed. Discussion: Taken together, these results highlight the anti-inflammatory potential of the AFC blend, probably due to the presence of flavonoids such as luteolin, apigenin and chrysin. This experimental evidence suggests that an AFC blend could be a good ingredient for food functionalization if further used in nutritional strategies.

Keywords: inflammatory bowel disease; phytochemical; inflammatory pathologies

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Fatty Acid Profile of Hemp Sprouts [†]

Nataša Đerić Ilić ^{*} , Sladana Rakita, Marina Đerić, Milana Matic, Alena Stupar, Milica Pojic and Aleksandra Mišan [†] 

Citation: Đerić Ilić, N.; Rakita, S.; Đerić, M.; Matic, M.; Stupar, A.; Pojic, M.; Mišan, A. Fatty Acid Profile of Hemp Sprouts. *Proceedings* **2023**, *91*, 284. <https://doi.org/10.3390/proceedings2023091284>

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various industries, such as food, animal feed, paper, textile, biofuel, etc. Hemp seeds intended for food production should not contain tetrahydrocannabinol (THC) level above 0.3%, according to Serbian legislation. Hemp seeds and their processed products, such as oil and flour, have high nutritional quality in terms of lipids, proteins, fiber, minerals, and plant secondary metabolites. The interest of society in healthy eating is rising constantly. Advice on the selection of foods which promote health includes functional food, such as sprouted seeds. Since hemp seed is rich in phytochemicals, it is assumed that their sprouts will be more nutrient-dense. Although sprouted seeds of many crops, such as legumes, cereals, pseudocereals, oilseeds, and vegetables are included in a healthy diet, hemp seed sprouting is barely studied. Therefore, the aim of this research was to determine the fatty acid profile of hemp sprouts harvested after seven days of germination which are ready for consumption. The majority of fatty acids in sprouts are polyunsaturated fatty acids (67.7%) comprising linoleic and α -linolenic acids. Sprouts are less abundant in oleic acid, monounsaturated fatty acid (10.5%), followed by saturated fatty acids (21.8%), with the highest content in palmitic acid. As it was expected, the fatty acid composition of seeds and sprouts is similar.

Keywords: functional food; sprouts; *Cannabis sativa*; industrial hemp; fatty acids

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Enhancing Bioactive Compound Extraction from Pumpkins Using Accelerated Solvent Extraction [†]

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Abstract: Pumpkins (*Cucurbita* spp.) are a widely cultivated vegetable in traditional agricultural regions. A high abundance of bioactive ingredients like carotenoids and polyphenols contribute to their status as a functional food, offering diverse health benefits such as antibacterial, antitumor, anti-inflammatory, and antihypertensive properties. This research aimed to optimize the accelerated solvent extraction (ASE) of pumpkin powder to obtain an extract with the highest yield of carotenoids and polyphenols. The targeted compounds were quantified using spectrophotometric analysis during pressurized liquid extraction. Antioxidant activity, assessed by DPPH and ABTS assays, was also determined using a spectrophotometer. The optimization process employed an artificial neural network (ANN) approach, investigating extraction parameters such as temperature, extraction time, and number of cycles. The results revealed that the ASE should be performed at an elevated temperature, with reduced extraction time and an average of two cycles, to achieve an optimal extract with elevated carotenoid and polyphenol content as well as high antioxidant potential. Further characterization of the optimal extract will involve analyzing its chemical composition and bioactivity, while future studies should explore different solution types. These findings hold promising applications for the functional food industry.

Keywords: ASE optimization; pumpkin; carotenoids; polyphenols; antioxidant activity



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Evaluating the Preservation of Bioactive Compounds in Encapsulated Powder of *Allium ursinum*[†]

Nataša Đerić Ilić^{1,*} , Alena Stupar¹, Senka Vidović², Milana Matic¹ and Aleksandra Mišan¹ 



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Abstract: Incorporating natural plant extracts as food additives offers promising benefits for improving food quality, nutrition, and safety. Therefore, the aim of this study was to develop an environmentally friendly process for obtaining solid powder from *Allium ursinum* liquid extract, which could be used as a natural food additive. The spray drying process was applied to overcome the instability and increase the solubility of bioactive compounds in *A. ursinum* extracts obtained by subcritical water extraction. The chemical and physical stability of the extracts are crucial for determining the shelf life not only of the extract itself, but also of products containing natural extracts. Therefore, it is important to determine whether the quality of the powder (its content of bioactive compounds and its physical characteristics) is affected during storage by environmental factors, such as temperature, oxygen, and relative humidity, in order to determine the best conditions for the storage of the powder. The powders obtained from aqueous *A. ursinum* extract were stored for three months, and the most important parameters were evaluated. The colour of the powders remained the same, and the powder kept loose, without sticking and forming lumps during the entire storage period. Physical analyses of the stored powders were compared with the results conducted on freshly prepared powders. No statistical changes were detected, proving that the powders remained stable regarding physical characteristics. The changes in the chemical composition, specifically total phenolics and total flavonoids, as well as the antioxidant activity, were monitored during the storage period at two-week intervals. The encapsulated powders showed excellent stability, with minimal loss of total phenolics (12.64%) and total flavonoids (10.52%) after three months of storage. Physicochemical analysis confirmed the successful preservation of bioactive compounds through microencapsulation using maltodextrin, suggesting its potential for application in new food products.

Keywords: spray drying; *Allium ursinum*; extract stability; natural additives

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The Importance of Rutin in Nutrition †

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Abstract: Flavonoids are a group of natural compounds, the main nutritional ingredients of food of plant origin. Rutin is a flavonoid that is widely distributed in plants, fruits, and many foods. It is often called vitamin P or rutoside. According to its chemical composition, it is a polyphenol of the flavonol type, consisting of the flavonol quercetin and the disaccharide rutinose. One of the best food sources of rutin is Tartary buckwheat (*Fagopyrum tataricum* Gaertn.), especially its sprouts. In addition to being obtained from food, rutin is available on the market today as a supplement in the form of tablets or capsules. Rutin is one of the best-known natural antioxidants in its category due to its powerful antioxidant effect. Many health benefits are attributed to rutin. The absorption of vitamin C and the synthesis of collagen in the body is one of them. Rutin improves circulation, strengthens blood vessels, prevents the formation of blood clots, and lowers cholesterol and blood pressure. It has been proven that rutin has anti-inflammatory, antibacterial, antifungal, antimicrobial, as well as anti-carcinogenic effects. Rutin is often used to relieve arthritis pain. In addition, there is evidence that rutin improves knee function in people with arthritis. Rutin has also been shown to be effective in the treatment of hemorrhoids. Studies have documented numerous pharmacological effects of rutin on the central nervous system. Current studies show that rutin is a phytochemical compound with various pharmacological effects. Therefore, rutin can be considered an essential phytochemical compound that needs to be investigated in detail in order to determine the efficacy and safety profile of its use in humans.

Keywords: rutin; flavonoids; pharmacological effects

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Green Approach in Obtaining Grape Extracts Displaying Cytotoxic Activity [†]

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Abstract: Background and objectives: Plant material is a real treasure of compounds possessing a spectrum of bioactivities. Their extraction is usually performed using toxic organic solvents, which causes serious environmental problems. For this reason, there is an aspiration to replace widely used organic solvents with greener ones. Natural deep eutectic solvents (NADES) were suggested at the beginning of this century as non-toxic, non-flammable and ecologically safe alternatives. Thus, the aim of the present study was to investigate the extraction efficiency of choline chloride (Ch)-based NADES (Ch with citric acid, molar ratio of 2:1, 30% of water, ChCit) in obtaining valuable extracts from grape skin. Materials and Methods: Eight different red grape varieties were collected. Skin separation was performed manually. Extraction was performed in an ultrasound bath under defined conditions (plant material/solvent ratio—1:10; time—30 min; temperature—50 °C). In parallel, acidified ethanol (EtOH) was used as a positive control. The total phenolic content (TPC) and the antioxidant and cytotoxic activities of the prepared extracts were explored. TPC investigations were performed using the Folin–Ciocalteu method. For antioxidant activity evaluation, four different in vitro assays were employed (DPPH, FRAP, ABTS and CUPRAC). Cytotoxic properties were tested against three cell lines (MRS-5, HeLa and LS 174T). Results and Discussion: TPC had a wide range (10.10–45.10 and 17.69–62.34 mg GAE/, for ethanol and ChCit, respectively), suggesting the strong influence of grape variety. ChCit showed higher efficiency in extracting polyphenols from grape skin compared with EtOH, probably since low ChCit pH potentiates anthocyanin extraction. Antioxidant activities displayed a strong correlation with TPC values ($p < 0.05$), confirming that phenols strongly contribute to the antioxidant properties of grape skin. The results for cytotoxicity were more heterogeneous. ChCit extracts inhibited cell growth (IC₅₀ between 70.4 and 400 µg/mL), while EtOH extracts had no effect for the tested concentrations. There is no clear relationship between the polyphenol content and cytotoxic effects. Conclusion: Considering all of the mentioned result, it is concluded that the synergy between induced cell acidity and the present bioactives resulted in a cytotoxic effect of grape skin, but there is still a need to identify the specific compounds responsible for this.

Keywords: grape skin; NADES; polyphenols; antioxidant activity; cytotoxic activity



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Assessing the Potential of a Freeze-Dried Apple Residue Extract to Protect Intestinal Epithelial Cells against Cellular Damage Induced by *Escherichia coli* Lipopolysaccharide †

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Citation: Taranu, I.; Pistol, G.C.; Perteu, A.-M.; Bulgaru, C.; Marin, D.E. Assessing the Potential of a Freeze-Dried Apple Residue Extract to Protect Intestinal Epithelial Cells against Cellular Damage Induced by *Escherichia coli* Lipopolysaccharide.

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Abstract: Apples are a fruit rich in active biomolecules, and are one of the most important fruits for human food. Apple waste also started to gain importance as potential feedstuff for farm animals after the ban on in-feed antibiotics. Large quantities of apples are consumed as such (~200 g/capita/day), but also as juice, and they are also used as a base for other juices. A large amount of residue containing active nutrients beneficial for health remains available, which could be added as pomace or meals to the feed of farm animals (e.g., pigs). The present study analyzed and compared the composition of three apple cultivars (Granny Smith, Golden, and Red Delicious) and investigated the capacity of the apple meal extract to counteract the membrane damage and pro-inflammatory effect induced by LPS on an in vitro cellular model of pig intestinal epithelial IPEC-1 cells, considering that the epithelium represents the first barrier for nutrient absorption, as well as against toxins and pathogens. The intestine is the first organ affected by inflammation in piglets during the weaning period, in which animals are frequently exposed to infections with pathogens such as *E. coli*, *Salmonella*, *Rotavirus*, etc. Cells were seeded in Transwell inserts in 24 well plates and treated with apple extract for 48 h. After 2 h of incubation, they were challenged with LPS until 48 h. The capacity of apple extract to protect cellular membrane permeability was evaluated by measuring the trans-epithelial electrical resistance (TEER) at 6, 24, and 48 h, and its potential to diminish the pro-inflammatory effect induced by LPS was also assessed by measuring the pro-inflammatory cytokines synthesis (ELISA). Red Delicious apple extract was used for the in vitro studies due to its higher level of micronutrients than the other two. Our results showed that LPS significantly reduced the TEER at all three measured times in a time-dependent manner, suggesting that the endotoxin disrupted the tight junctions' proteins and as a consequence the epithelial integrity. But apple extract was efficient to defend the cells against the increased membrane permeability caused by LPS. It was also able to prevent the over-production of pro-inflammatory markers triggered by LPS.

Keywords: apple residue extract; intestinal cells; LPS

Author Contributions: Conceptualization, I.T.; Investigations, D.E.M., C.B., G.C.P. and A.-M.P. All authors have read and agreed to the published version of the manuscript.

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The Effects of Fermentable Dietary Fibre Supplementation on Intestinal Barrier Function, Intestinal Microbiome, and Inflammation in Microscopic Colitis Patients—A Randomised, Triple-Blinded, Placebo-Controlled Trial [†]

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Abstract: Background: Microscopic colitis (MC) is a chronic inflammatory disease of the colon that primarily manifests as chronic watery diarrhoea. The aetiology of MC is still unknown, but the current hypothesis states that MC results from an abnormal immune response to luminal antigens in predisposed individuals. Studies have also shown that MC patients often display an increased intestinal permeability and alterations in the intestinal microbiota, which likely contribute to sustained intestinal inflammation. In this study, we aimed to examine how a dietary fibre known to promote luminal butyrate production affects intestinal homeostasis and gastrointestinal symptoms in MC patients. Methods: A total of 24 participants with a confirmed MC diagnosis were randomised into 2 study arms: The active treatment arm consumed 24 g of a wheat-based dietary fibre supplement daily for 6 weeks. The placebo arm consumed 24 g of maltodextrin daily. Blood and faecal samples were collected both at baseline and at the end of the intervention period. In vivo intestinal permeability was assessed with a multi-sugar test that allows the simultaneous measurement of gastroduodenal, small intestinal, and colonic permeability. The composition of the faecal microbiome was analysed with shotgun sequencing using the Illumina NextSeq2000 platform. The plasma concentrations of several inflammatory cytokines and chemokines were analysed using commercially available assays. The study protocol is registered at clinicaltrials.gov (NCT05058131). This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 896263 and from Lantmännens Forskningsstiftelse. Results: A total of 22 (7 males, 16 females) participants completed both study visits. The median age of the participants was 65.6 (32–75). The study remains blinded, and the analyses are ongoing. Our preliminary group-wise analyses showed a statistically significant increase in the relative abundance of butyrate-producing bacteria in group A compared to group B. However, we did not observe any group-level differences in the measured cytokines or in the severity of gastrointestinal symptoms. The urinary excretion of the sugar probes assessing intestinal permeability will be measured with UPLC/MS/MS. Conclusions: The increase of butyrate-producing bacteria does not appear to lead to any significant improvements in the clinical symptoms of MC.

Keywords: microscopic colitis; dietary fibre; intestinal barrier function

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The Effect of Bitter Melon and Chromium(III) Supplementation on the Mineral Status of Rats Fed a High-Fat Diet [†]

Zbigniew Krejpcio * , Ewelina Król, Jakub Kurek , Halina Staniek  and Szymon Ziemak



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Abstract: A diet rich in simple sugars and high in fat promotes the development of diseases such as obesity, diabetes and heart disease. A high-fat diet causes changes in the carbohydrate–lipid metabolism, but may also reduce the absorption of certain elements. According to the available literature, the hypoglycemic potential shows, among other things, bitter melon and chromium(III). The aim of this work was to determine the effect of these preparations on the Fe, Zn and Cu status in experimental animals. The experiment was conducted on 60 male Wistar rats. In the first stage, 10 rats received a standard diet, while 50 rats were fed a high-fat diet for 6 weeks to induce insulin resistance. Then, these rats were divided into five groups: one group fed a high fat diet, and four groups fed diets supplemented with two doses of lyophilized bitter melon (1 vs. 5% of diets) and chromium propionate (10 vs. 50 Cr mg/kg diet) for 6 consecutive weeks. During the autopsy, internal organs (liver, kidneys, spleen and heart) were collected. The content of Fe, Zn and Cu in tissues was determined by the AAS method followed by microwave digestion. Statistical analyses included both one-way and two-way (treatment × dose) analysis of variance. It was found that the high-fat diet lowered Zn and Cu in the liver and kidney, and also decreased Fe in the spleen. The 2 × 2 analysis showed that Cr(III) supplementation dose-dependently increased Zn in the spleen, while BM significantly decreased Zn in the heart. The interactions between those factors were noticed. An interaction analysis showed that the higher dose of BM significantly normalized the levels of Zn and Cu in the liver and Fe in the spleen only at the lower dose of Cr(III). In addition, a lower dose of BM and a higher dose of Cr(III) reduced the level of Cu in the heart. In conclusion, simultaneous supplementation with Cr(III) and BM is effective in improving the mineral status of rats fed a high-fat diet only when one of them is used at a lower dose.

Keywords: bitter melon; chromium; high fat; minerals

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Author Contributions: Conceptualization, Z.K. and E.K.; methodology Z.K., E.K. and H.S.; validation, Z.K. and E.K.; formal analysis, Z.K. and E.K.; investigation, E.K., H.S. and S.Z.; data curation, J.K.; writing—original draft preparation, E.K. and Z.K.; funding acquisition, Z.K. and E.K. All authors have read and agreed to the published version of the manuscript.

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Evaluation of the Effect of Elderberry (*Sambucus nigra*) Fruit Extracts on Calcium and Magnesium Status in STZ-Induced Diabetic Rats [†]

Zbigniew Krejpcio ^{1,*} , Ewelina Król ¹, Halina Staniek ¹ , Jebutu Molayooluwa Oluwatobi ¹, Silvia M. Rocha ² , Angelo Salvador ² and Jakub Kurek ¹ 



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Evaluation of the Effect of Elderberry (*Sambucus nigra*) Fruit Extracts on Calcium and Magnesium Status in STZ-Induced Diabetic Rats. *Proceedings* **2023**, *91*, 228. <https://doi.org/10.3390/proceedings2023091228>

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Abstract: Diabetes mellitus (DM) is one of the most prevalent lifestyle diseases with an increasing impact on human health. Chronic hyperglycaemia in diabetes leads to various metabolic disorders such as protein glycation, fluid and mineral imbalance, and deterioration of tissues. Currently available pharmacological treatments of DM help control glycaemia and slow down diabetic complications. On the other hand, they can also cause various side effects. Medicinal plants can contribute to controlling hyperglycemia and reducing diabetic complications. One such plant is the elderberry (*Sambucus nigra* L.) which contains several biologically active phytochemicals and minerals that can support in the therapy of DM. The objective of this study was to evaluate the effect of elderberry fruit extract (lipophilic (LFSn) and phenolic (PhFSn) fractions) supplementation on the calcium and magnesium status in diabetic rats. The experiment was performed on 32 male Wistar rats which were divided into four groups: healthy control, diabetic control, diabetic treated with LFSn (1.5 g/kg b.w./day) and diabetic group treated with PhFSn (5 g/kg b.w./day) for 4 weeks. Hyperglycaemia (diabetes) was induced by feeding rats with a high-fat diet and STZ injections (55 mg/kg b.w.). After a four-week test period, animals were sacrificed to collect blood, internal organs and femoral bones for biochemical assays. The Ca and Mg status was evaluated on the basis of the contents of these minerals in the blood serum, liver, kidneys and femoral bones, using the AAS method. The tissue samples were mineralized in 65% nitric acid (MW oven). The results were evaluated statistically using software Statistics ver. 13.0, at $p < 0.05$. It was found that chronic hyperglycaemia disturbed Ca and Mg status which was evidenced by a significant loss of tissular Mg content and calcification of kidneys in diabetic rats. Treatment with both types of *Sambucus nigra* fruit extracts normalized the kidney Ca content, while PhFSn extract decreased the liver Mg content in diabetic rats. The results demonstrated an appreciable potential of *Sambucus nigra* fruit extracts in ameliorating the Ca and Mg imbalance in diabetic rats.

Keywords: *Sambucus nigra* fruit extracts; calcium; magnesium; diabetes; rats

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A Green Approach for Isolation of Phytochemicals from Lamiaceae Plants [†]

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Abstract: Deep eutectic solvents (DESs) are now widely recognized as a new class of ionic liquid analogues and have large-scale usage as green solvents. Due to their superior characteristics compared to traditional organic solvents, DESs are increasingly being used. The aim of the work was to examine the effectiveness of DES extractants of phenolic compounds from monocomponent teas from plants of the Lamiaceae family produced at the Institute for the Study of Medicinal Plants, “Dr. Josif Pancić”. Ten samples of herbal drugs (basil, thyme, savory, oregano, sage, thyme, mint, lavender, rosemary, and lemon balm) were tested. Extraction was performed with two types of DESs (a mixture of menthol and methylsalicylate (1:1) and a mixture of menthol and dodecanoic acid (2:1)), as well as microwave and traditional extraction. The content of phenolic acids and flavonoids in the tested preparations was determined using high-performance liquid chromatography (HPLC). Menthol–methylsalicylate and menthol–dodecanoic acid mixtures showed significant efficiency in the isolation of quercetin and naringenin from herbal drugs, while the effectiveness of the menthol–methylsalicylate mixture stands out in the isolation of chlorogenic acid and cinnamic acid from all samples, as well as rosmarinic acid from basil. The concentration of quercetin ranged from 0.2035 to 0.7543 mg/g of the drug for the menthol–methylsalicylate mixture, and from 0.1189 to 0.2025 mg/g of the drug for the menthol–dodecanoic acid mixture. In this study, an environmentally friendly, economical, and efficient extraction based on menthol and methylsalicylate, and also menthol and dodecanoic acid, was applied. Based on the results presented, DESs may be useful in the isolation of target compounds from plants. This research represents an excellent basis for further research and testing of other green solvents as new extractants.

Keywords: DES; green solvents; phenols; flavonoids; extraction

Author Contributions: Conceptualization, B.T. (Branislava Teofilovic¹) and N.G.-L.; methodology, B.T. (Branislava Teofilovic¹); software, E.G.; validation, M.V., S.P. and Ž.G.; formal analysis, B.T. (Biljana Tubic³); investigation, B.T. (Branislava Teofilovic¹); resources, B.T. (Branislava Teofilovic¹); data curation, E.G.; writing—original draft preparation, B.T. (Branislava Teofilovic¹); writing—review and editing, N.G.-L.; visualization, S.P.; supervision, M.V.; project administration, M.V.; funding acquisition, N.G.-L. All authors have read and agreed to the published version of the manuscript.

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The Effect of Higenamine Supplementation on the Fatty Acid Profiles of Serum Phospholipids [†]

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Abstract: Background and objectives: Higenamine is an alkaloid found in different plant species like *Aconitum japonica*, *Nandina domestica*, *Gnetum parvifolium*, and *Asarum heterotropoides*. According to the available data in the literature, its dietary intake leads to an enhancement of lipolysis. The objective of this study was to explore whether the ingestion of a one-component higenamine supplement (75 mg/day) for three weeks would introduce some changes in the fatty acid (FA) profiles of serum phospholipids of female recreational athletes. Methods: A total of 12 female recreational athletes were included in a double-blind study, with six participants in both groups—a higenamine treatment group and placebo group. Serum phospholipids were isolated via one-dimensional thinlayer chromatography. Fatty acid methyl ester samples from the phospholipids were analyzed by a gas–liquid chromatography method. Desaturase and elongase activities were calculated from product/precursor FA ratios. Results: In the group that was undergoing higenamine treatment, a statistically significant increase in the levels of linolenic acid, a total n – 6 polyunsaturated FAs (PUFAs), and an n – 6/n – 3 FA ratio were observed. But saturated palmitic acid and monounsaturated palmitoleic and oleic acid, as well as consequent total saturated FAs and monounsaturated FA acids decreased in serum phospholipids. Also, after 3 weeks of higenamine supplementation, arachidonic n – 6 acid and docosapentaenoic n – 3 acids levels were significantly decreased, and estimated delta-5 desaturase activity (arachidonic/dihomo-gamma-linolenic acid ratio) was decreased too. In the placebo group, a significant change was increased levels of oleic acid compared to baseline levels. Conclusion: According to the results obtained for the FA status of serum phospholipids, treatment with higenamine was followed by a modulation of serum phospholipid FA profiles. Furthermore, this could influence the desaturation/elongation metabolic pathway of endogenous FA metabolisms, leading to a decrease in delta-5 desaturase activity and consequently lower levels of long-chain PUFAs. For further discussion, it is necessary to assess the dietary intake of study participants.

Keywords: higenamine; recreational athletes; fatty acid profile; serum phospholipids; dietary supplements

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From the Literature to Our Cells: A Critical Appraisal of the Bioactivity and Role of Vitamin C, Folate, and Riboflavin in Nutrition and Health Claims [†]

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Abstract: Background and objectives: Fruits and vegetables are rich in components with healthpromoting effects, such as vitamins. However, lack of compliance with the recommended ‘5-a-day’ is an issue most nations face. While these plant-based foods contain high levels of vitamins and other bio-compounds, their bioavailability is questionable. Considerable research and legislation have been devoted to vitamins and claims that they promote health. However, little has been investigated about the overlap between what is active in our bodies and what is authorised. In this study, we adopt a dual approach: first by presenting the theory and body of evidence on bioavailability and legislation and second by extending this knowledge to a practical case in light of nutrition and health claims. Methods: We selected three vitamins regularly subjected to claims: vitamin C, riboflavin, and folate. By conducting thorough literature research, we evaluated the logical order from how these compounds are used in our bodies (‘In our cells’) through to how they are characterised (‘In regulation’) and how they are measured (‘In the lab’). To illustrate this critical appraisal, we present an analysis of these vitamins from a sample of cucumbers of different varieties. Results: We observed that bioavailability is a rather complex concept for the three vitamins analysed. In particular, in fruits and vegetables, these water-soluble vitamins are registered as unstable and labile during processing and storage. Furthermore, the characterisation of such vitamins in regulations and general knowledge of the targeted compounds seems oversimplified. Likewise, measuring protocols should be detailed and focus on the bioactive forms of vitamins in humans. Discussion: The conclusions from these analyses set out the state-of-the-art on vitamins that can be characterised and measured and the implications of these findings for the use of nutrition and health claims. A better understanding of what each vitamin entails for the decision-makers of claims and users of composition data is needed. These insights will help to harmonise what is measured in the lab, regulated by EU law, and taken up in our cells.

Keywords: bioaccessibility; bioactivity; European food law; fresh produce; nutrient composition



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Nutritional Composition, Biologically Active Substances and Antioxidant Activity of Selected Edible Wild Plants from Montenegro †

Dejan Jancic *, Danijela Sukovic, Jelena Resetar and Marko Nikolic



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† Presented at the 14th

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Abstract: The aim of this study was to determine the nutritional composition and biologically active substances (BAS) of wild edible plants from Montenegro. Nettle (*Urtica dioica* L.) leaves, rosehips (*Rosa canina* L.), and the fruit of the strawberry tree (*Arbutus unedo* L.) were investigated regarding several nutrients, major and trace elements, fatty acid composition, amounts of pigments, and total phenols and flavonoids. Antioxidant activity

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was also determined using three methods (DPPH, FRAP, and ABTS), and the results obtained from all the tests were used to calculate the antioxidant potency composite index (ACI). The results of this study indicate that these plant parts are potential sources of useful nutrients such as macro and micro elements. The majority of fats in all the plant parts consist of unsaturated fatty acids, while saturated fatty acids were represented mainly by palmitic acid. Chlorophyll a and b, zeaxanthin, lutein, and β -carotene were the main pigments in nettle leaves. The pigment profiles of the fruit samples were characterized by the presence of β -carotene, zeaxanthin, and lutein, in addition to pheophytin only in the strawberry tree fruit. The ACI index had a good correlation with the total phenolic and total flavonoid content. All these features reinforce the interest in including these wild edible plants in modern diets as a healthy alternative.

Keywords: nutritional composition; biologically active substances; antioxidant activity

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Abstract

Volatile Organic Profile of *Pinus nigra* Arnold Bark [†]

Maja Milanovic ^{*} , Ljilja Torovic ^{*} , Jovana Drljac ^{*} a Lero, Nataša Milošević ^{*} and Nataša Milic ^{*}



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Abstract: Volatile organic compounds (VOCs) emission from trees and other plants depends on various factors such as species, age, and biochemical characteristics, as well as the interaction with fungi and insects. VOCs derive from the tree native structure and/or are produced via oxidation and hydrolysis from wood components. The aim of this study was to determine VOCs in *Pinus nigra* Arnold bark extracts. *Pinus nigra* Arnold bark was sampled from the mountains Tara and Mokra Gora (Republic of Serbia). Dichloromethane and hexane were used as pure solvents and conventional liquid–liquid extraction (LLE) and ultrasound extraction were applied. Prepared extracts were analysed by gas chromatography coupled with a mass spectrometry detector. The NIST and Wiley libraries were used for the identification of VOCs. After analysis of the VOCs' abundance and peak areas, dichloromethane was chosen as a more efficient solvent in comparison with hexane. The ultrasound

technique was more effective for VOC extraction versus the conventional LLE. Additionally, bark extracts from Mokra Gora contained diverse VOCs in contrast to the ones obtained from the Tara locality. The main VOCs were monoterpenes, such as α - and β -pinene, camphene and limonene. In addition, sesquiterpenes: humulene, germacrene D, longipinene, longifolene and cadinene, as well as oxygenated terpenes such as verbenone and α -terpineol, were detected in bark extracts. The obtained results showed that location strongly affects the VOC profile in *Pinus nigra*.

Keywords: pine bark; monoterpenes; GC-MS

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Acute Aronia Juice Consumption Prior to Half-Marathon Races Affects Proteinuria-Induced Changes of Serum Protein Profiles [†]

Marija Takic ^{1,*}, Tamara Uzelac ², Nevena Vidovic ¹, Vuk Stevanovic ¹, Ana Pantovic ¹, Marija Glibetic ¹ and Vesna Jovanovic ²



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Abstract: Physical activity could lead to dehydration and post-exercise proteinuria. In several animal studies, it has been noticed that aronia juice consumption shows favorable effects on the kidney function. Therefore, the primary aim of this study was to examine the influence of acute aronia juice supplementation before simulated half-marathon races on serum protein profiles that reflect both changes induced by dehydration and proteinuria in ten recreational runners. The serum protein profiles were determined before (T0), 15 min (T1), 1 h (T2), and 24 h after the race (T3), and were presented as a percentage abundance of HSA and non-albumin fractions (γ , β_2 , α_1 , and α_2) obtained through the densitometric analysis of gels after the separation of serum proteins via native electrophoresis. Before the first race, our recreational runners had decreased percentages of α_1 - and α_2 -globulins and increased percentages of γ -globulins compared to the literature values for healthy subjects. At time points T2 and T3, after simulation of the half-marathon races, the significant increase ($p < 0.05$) in γ fraction percentages was noticed after the placebo, but not the acute aronia juice treatment. According to the obtained results, long-term physical activity in recreational runners induces changes in serum protein profiles, probably due to the protein loss of low-weight proteins after exercise. At the same time, this study has shown that the acute consumption of aronia juice before intensive physical activity could exert a beneficial effect on post-exercise proteinuria.

Keywords: polyphenols; antioxidants; sports nutrition

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Acute Aronia Juice Consumption Affect HSA Thiol Group Content in Recreational Runners after Simulation of Half-Marathon Race [†]

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Abstract: Aronia melanocarpa berries and their products are rich dietary sources of antioxidant compounds with polyphenolic structures, including anthocyanins, flavonoids, procyanidins and phenolic acids. Physical activity (PA) can lead to oxidative stress and reduced thiol group of human serum albumin (HSA-SH). HSA-SH is the key component of the antioxidant system for maintaining serum thiol homeostasis. In this study, the main goal was to examine the effect of aronia juice supplementation before a race on thiol homeostasis in 10 recreational runners, in a single blind crossover placebo-controlled study. Total serum thiols, HSA-SH group content and reactivity, and free fatty acids (FFAs)/HSA ratios were determined before, 15 min (T1), 1 h (T2) and 24 h (T3) after the simulation of a half-marathon race and the consumption of aronia juice (AG) or placebo (PG) before the race. Reduced thiols content and the pseudo-first order kinetic constant of the HSA-SH group's reactivity were determined using 5,5'-dithiobis-(2-nitrobenzoic acid) reagent. Accordingly, PA led to transient oxidative stress, which decreased the HSA-SH group's content in T1 compared to the baseline, and when compared to the AG ($p < 0.01$, and $p < 0.05$, respectively), but there was no significant change in total thiol content. At the same time, the HSA-SH group's reactivity and FFA/HSA ratio increased significantly in T1 and T2 in both groups compared to corresponding baseline values. The positive effect of acute aronia juice consumption on the oxidative stress by reducing oxidative damage of HSA-SH group during PA was revealed in the study. Also, this study indicated that HSA-SH content is a more reliable parameter for the evaluation of oxidative stress during PA than the analysis of total serum thiols.

Keywords: polyphenols; antioxidants; sports nutrition



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The Contribution of Short-Chain Fatty Acids to Health Benefits May Depend on the Site of Absorption: A Mechanistic Study Design [†]

Riet Rosseel *  and Kristin Verbeke



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Abstract: The fermentation of dietary fibres in the human colon generates short-chain fatty acids

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(SCFAs) that potentially mediate the health benefits associated with high fibre intake. In the colonic lumen, SCFAs support gut health and stimulate the release of the appetite-regulating hormones glucagon-like peptide 1 (GLP-1) and peptide-YY (PYY). In addition, SCFAs act as fuel for colonocytes and serve as precursors for substrate metabolism in the liver. The SCFAs that ultimately reach the systemic circulation may influence physiological processes in organs at a distance. Yet, when consuming plant-based fermented foods containing SCFAs, the SCFAs are absorbed in the small intestine and will not reach the colon, which might affect their physiological effects. We hypothesise that, compared to colonic delivery, a larger fraction of SCFAs will reach the systemic circulation and that the stimulation of gut hormone release will be less pronounced. To test this hypothesis, we designed two randomised crossover human intervention studies in healthy participants in which SCFAs will be targeted either to the small intestine (test day 1) or colon (test day 2) using standard capsules or capsules with a colon delivery coating, respectively. Study 1 will assess the systemic bioavailability of postprandial concentrations of labelled SCFAs after oral administration of stable isotope ¹³C-labelled SCFAs and intravenous administration of ²H-labelled SCFAs. In study 2, postprandial concentrations of GLP-1 and PYY, glucose, and insulin will be quantified after the administration of capsules with unlabelled SCFAs. These studies will clarify the importance of the site of administration on the kinetics of SCFAs and the gut hormone release that will contribute to elucidating the role of SCFAs as health-supporting metabolites.

Keywords: short-chain fatty acids (SCFAs); systemic bioavailability; glucagon-like peptide 1 (GLP-1); peptide YY (PYY); stable isotope; targeted delivery

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The Effect of Probiotics on the Response to Vaccination in Older Adults: A Systematic Review of Randomised Controlled Trials [†]

Hediye Arioz Tunc *  and Philip Calder



Citation: Arioz Tunc, H.; Calder, P. The Effect of Probiotics on the Response to Vaccination in Older Adults: A Systematic Review of Randomised Controlled Trials. *Proceedings* **2023**, *91*, 171. <https://doi.org/10.3390/proceedings2023091171>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: Ageing comes with alterations in many body functions, including the deterioration of the immune system, referred to as immunosenescence. Consequently, older individuals

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are more vulnerable to infectious diseases. Vaccines are used to stimulate protective immunity, and response to vaccination has been proposed as a measure of immune vigour. Through alterations in gut microbiota, probiotics may improve the immune response in older people. This can be tested by measuring the response to vaccination. Objectives: To evaluate the impact of oral probiotics on the immune response to vaccination in older people. Methods: A systematic review was conducted to determine the effect of probiotics on vaccine responses. A search of the literature was performed in three electronic databases up to January 2023. Eligible papers reporting randomised controlled trials (RCTs) were identified using inclusion/exclusion criteria. The characteristics and outcome data of the included studies were extracted and analysed. The quality of the studies was assessed using the Cochrane Risk of Bias Tool for randomised trials. Results: Ten RCTs, reported in nine papers, were included. A total of 1560 participants aged over 60 years were included in these studies. Nine studies involved the seasonal influenza vaccine, and one involved a COVID-19 vaccine. All studies used lactobacilli, some in combination with bifidobacteria. The studies reported various outcomes including anti-vaccine antibody titres or concentrations, seroconversion, and seroprotection. Some studies reported higher outcomes in participants receiving probiotics compared with placebo. Several studies were at a high risk of bias due to missing outcome data. When comparing antibody titres, the seroprotection rate and seroconversion rate between probiotic and placebo groups were expressed as a response ratio, and the average values were 1.3, 1.41, and 1.92, respectively. Although the results for antibody titres and seroprotection rates suggest that probiotics improve outcomes, they do not provide clear evidence. However, the average seroconversion rate in the probiotic group was almost twice that of the placebo group, suggesting that probiotics are a promising strategy for improving the seroconversion rate following seasonal influenza vaccination. Conclusion: Probiotics (lactobacilli) may improve the vaccine response, but further research is needed to be more certain of this.

Keywords: probiotic; immunity; elderly; vaccine response; systematic review

Author Contributions: Conceptualization, H.A.T. and P.C.; methodology, H.A.T.; formal analysis, H.A.T.; investigation, H.A.T.; data curation, H.A.T.; writing—original draft preparation, H.A.T.; writing—review and editing, P.C.; supervision, P.C.; project administration, P.C. All authors have read and agreed to the published version of the manuscript.

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Health Beneficial Effects of Carotenoids Related to Their Interactions with Gut Microbiota [†]

Torsten Bohn ^{1,*}, Abdulkerim Eroglu ², Ibrahim S. Al'Abri ², Rachel E. Kopec ³ and Nathan Crook ²



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Citation: Bohn, T.; Eroglu, A.; Al'Abri, I.S.; Kopec, R.E.; Crook, N. Health Beneficial Effects of Carotenoids Related to Their Interactions with Gut Microbiota. *Proceedings* **2023**, *91*, 170. <https://doi.org/10.3390/proceedings2023091170>

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Abstract: Background: Carotenoid intake and plasma concentrations have been associated with several health benefits, including a reduced risk for diabetes, obesity, cardiovascular diseases, and some types of cancer. However, their absorption is low, and the main fraction is passed on to the colon. Very little is known about the potential interactions of carotenoids and the gut microbiota, though carotenoids and their potential metabolites, such as apocarotenoids, may be potent and have beneficial effects on the gut and at the systemic level. Methods: In this review, we strive to highlight the state-of-the-art knowledge on carotenoids and gut microbiota interactions, based on research on the literature (PubMed, Scopus). Results and discussion: Several studies, ranging from in vitro to in vivo including humans, have suggested health beneficial effects related to altered gut microbiota diversity and abundance of different phyla. The potential mechanisms are yet somewhat elusive, but include apo-carotenoid formation and such compounds, which may have a higher electrophilicity compared to their native compounds, acting as better targets for transcription factors such as NF-κB and Nrf2 and nuclear receptors, i.e., PPARγ, and RAR/RXRs. A number of bactericidal effects have also been reported, and altered gut redox potential may also play a role. Furthermore, pre-biotic effects causing bacterial shifts to those related to health beneficial properties have likewise been mentioned. Finally, stimulation of IgA and immune-related responses could also play a role, related to contributing to mucosal health and gut barrier integrity. An interesting novel strategy to fostering gut health may be the supplementation of probiotic strains such as *Bacillus indicus*, producing carotenoids in the colon. In summary, though our understanding of the interactions of carotenoids with the gut microbiota is rather limited, these colorful pigments may constitute a promising route to improving gut health and functionality and contributing to systemic health benefits.

Keywords: carotenoids; large intestine; gut microbiota; bioavailability; health aspects

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Author Contributions: A.E. and T.B. designed the outline of the manuscript and wrote large parts of it; R.E.K. wrote the chapter on carotenoid processing during digestion and on apo-carotenoids and further proofread the manuscript; I.S.A. and N.C. contributed in writing several subchapters regarding carotenoid microbiota metabolism and synthesis. All authors have read and agreed to the published version of the manuscript.

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Antioxidant Activity of Culinary-Processed Food [†]

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Citation: Sejbuk, M.; Zinkow, A.; Kuczynska, M.; Cyunczyk, M.; Mironczuk-Chodakowska, I.; Witkowska, A.M. Antioxidant Activity of Culinary-Processed Food. *Proceedings* **2023**, *91*, 158. <https://doi.org/10.3390/proceedings2023091158>

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Abstract: Background: Exogenous compounds with antioxidant activity mainly include plant compounds such as polyphenols, β -carotene, lycopene, vitamin C and vitamin E. Culinary processing significantly affects the organoleptic characteristics and nutritional value of food. However, little is known about the effect of cooking processing on the antioxidant activity of foods. Objectives: This study aimed to investigate whether cooking processes affect the antioxidant activity of foods and whether there are differences in antioxidant activity between different foods. Materials and methods: Raw materials were used to prepare raw and cooked soups. Four model raw and four cooked soups (tomato, cucumber, cauliflower, vegetable) were prepared according to recipes given in Polish food composition tables, each in triplicate. Samples were lyophilized and extracted with the following solvents: methanol/water (90:10 vol.) and acetone/water/acetic acid (70:29.5:0.5 vol.). Antioxidant activity was determined by an electrochemical method using the e-BQC analyzer, Bioquochem, Spain, and expressed in μC , and by the FRAP spectrophotometric method according to Benzie and Strain, in which values were expressed in $\text{mM}/100\text{g}$ dry weight. The Kolmogorov–Smirnov and Wilcoxon tests were used for intergroup comparisons and the Spearman test was used for correlations. Results: Antioxidant activity measured by the electrochemical method was found to be higher in acetone extracts compared to methanol extracts ($p < 0.05$) in terms of Q1 (fast-acting antioxidants), Q2 (slow-acting antioxidants) and QT (total charge) parameters. No significant differences were found by FRAP between methanolic and acetone extracts ($p = 0.057$). In acetone extracts, higher antioxidant activity was found in cooked soups compared to raw soups for tomato, cucumber and cauliflower soups. In both methanolic and acetone extracts, the antioxidant activity determined by the electrochemical method (parameter Q1) correlated with the FRAP method: 0.92 and 0.63, respectively. No correlation was found between the FRAP method and parameter Q2 of the electrochemical method in either extract. Discussion: The model soups had different antioxidant activities, but it was higher for boiled soups, which may be related to the better availability of antioxidants after cooking. The methanol extraction method allows the extraction of compounds that similarly affect the antioxidant activity determined by the electrochemical and FRAP methods.

Keywords: antioxidant activity; food; culinary processing; electrochemical method; FRAP method

Author Contributions: Conceptualization, M.S., A.M.W., and I.M.-C.; methodology, M.S., A.M.W. and I.M.-C.; software, M.S. and A.M.W.; validation, I.M.-C.; formal analysis, M.S., A.Z., M.K. and M.C.; investigation, M.S., A.Z., M.K. and M.C.; resources, A.M.W. and M.C.; data curation, A.M.W.; writing—original draft preparation, M.S., A.Z. and M.K.; writing—review and editing, A.M.W. and I.M.-C.; supervision, A.M.W. and I.M.-C.; project administration, A.M.W.; funding acquisition, A.M.W.

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The Impact of Inorganic Nitrate-Rich Beetroot Juice on Microvascular Blood Flow, Cognitive Function, and Other Hemodynamic Outcomes in Postmenopausal Women [†]

Begum Celik ^{1,*}, Jeremy Spencer ¹, Daniel Lamport ² , Noa Argomaniz ³ and Charlotte Mills ¹



Flow, Cognitive Function, and Other Hemodynamic Outcomes in Postmenopausal Women. *Proceedings*

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The Impact of Inorganic Nitrate-Rich Beetroot Juice on Microvascular Blood

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: Inorganic nitrate found in beetroot and green leafy vegetables has been demonstrated to reduce cardiovascular disease risk factors, including reducing blood pressure (BP) and the stiffness of blood vessels by increasing levels of nitric oxide (NO). The most beneficial effects of inorganic nitrate have been observed in young, healthy populations, whereas its impact on at-risk populations, such as postmenopausal women, is currently unknown. Objective: the primary aim of the trial is to evaluate the effectiveness of nitrate-rich beetroot juice in enhancing microvascular blood flow and cognitive function in postmenopausal women. Methods: We conducted a double-blind, three-armed, randomised, and controlled crossover trial with 24 postmenopausal women (aged 45 or older and having not had a period for over one year). The interventions were beetroot juice (BJ), nitrate-depleted BJ (NDJB), or NDBJ supplemented with potassium nitrate (0.4 g) to concurrently test if betalains, as well as nitrate, play a role in the vascular and cognitive effects. Cognitive tasks (episodic memory: Rey auditory verbal learning test; executive function: Stroop task, digit span backward and forward) and microvascular function (Laser Doppler Imaging (LDI) with iontophoresis; endothelium-independent and -dependent) were measured in participants before and 2.5 h after ingestion of the intervention. In addition, BP was measured in triplicate every 15 min from the baseline for 2.5 h. Results: The baseline characteristics of the participants recruited to date are as follows (mean and standard deviation)—age (years): 60 ± 5 , BMI (kg/m^2): 23.8 ± 3.1 , systolic BP (mmHg): 120 ± 14 , and diastolic BP (mmHg): 75 ± 8 . Early results indicated no significant difference between the groups with respect to SBP or DBP. A statistical analysis of the full data set, including endothelium-dependent and -independent microvascular function and cognitive tests, will be presented. Discussion: the results of this trial will help shed further light on the impact of dietary nitrate and the phytochemicals present in beetroot on human vascular and cognitive function.

Keywords: beetroot; nitrate; NO; microvascular reactivity; LDI; cognition; RAVLT; post-menopause; RCT

Author Contributions: The study was designed by B.C., C.M. and J.S., B.C. conducted the research, analysed the data, and wrote the manuscript. N.A. contributed to the conduct of the research. D.L. provided advice for cognitive test design and statistical analysis. All authors read, modified, and approved the final manuscript. All authors have read and agreed to the published version of the manuscript.

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Fruit Covered Functional Candied Chestnut Production: Nutritional and Technological Effects of Riboflavin Fortification and Copigmentation [†]

Özlem Erdog̃du * , Ahmet Görgüç, Yağmur Yıldırım, Ceylin S,ahin, Melisa Terekli and Fatih Mehmet Yılmaz



Citation: Erdog̃du, Ö.; Görgüç, A.; Yıldırım, Y.; S,ahin, C.; Terekli, M.; Yılmaz, F.M. Fruit Covered Functional Candied Chestnut Production: Nutritional and Technological Effects of Riboflavin Fortification and Copigmentation. *Proceedings* **2023**, *91*, 109. <https://doi.org/10.3390/proceedings2023091109>

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Abstract: The food industry offers innovative approaches in accordance with the changing demands of consumers. Developing functional formulations that may have positive effects on human health in addition to the nutritional feature of food has become a very popular approach. Chestnut (*Castanea sativa* Mill.) has many ways of being consumed, and one of them is candied chestnuts. Candied chestnuts, which are one of the gastronomic products, is offered on the market as whole or broken. Broken candied chestnuts, which have less economic value than whole candied chestnuts, are consumed directly or with a chocolate coating. There are no examples of fruit-coated candied chestnut production. The objective of this research was to produce an alternative and functional new food product by coating broken chestnut candies with pomegranate juice concentrate. Within the scope of the research, four different formulations of fruit-coated candied chestnuts were produced: candied chestnuts coated with solely pomegranate juice concentrate (I), pomegranate juice concentrate coated candied chestnuts with copigment agent (II), riboflavin fortified pomegranate juice concentrate coated candied chestnuts (III), and candied chestnuts coated with riboflavin-fortified and copigment agent added pomegranate juice concentrate (IV). Pomegranate peel phenolic extract as a copigment agent was obtained via microwave-assisted extraction followed by evaporation. The added amount of copigment agent was decided by determining the total phenolic content of the obtained extract (23.1 mg GAE/g) and the total monomeric anthocyanin content of the pomegranate juice (62.7 mg cyn-3-glu/kg). Riboflavin was added to the coating material at a ratio of 50 mg/product to meet the daily intake of individuals. The products were finally packed via aluminum polyethylene (ALPE) packages and stored for two months at 4 °C. Texture, color, total phenolic content, anthocyanin content and antioxidant capacity analyses were performed each 15 days of the 60-day storage period.

This study was financially supported with a fund from The Scientific and Technological Research Council of Türkiye (TUBITAK-BIDEB 2209-A).

Keywords: candied chestnut; copigment agent; bioactive compounds; pomegranate juice concentrate; riboflavin fortification

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Short-Term Effects of a Snack Including Fruit Juice Enriched with Vitamin D3, n-3 Fatty Acids, and Probiotics on Energy Intake and Satiety in Normal-Weight and Overweight Individuals [†]

Christina Athanasaki ^{1,*}, Nikolaos Zacharodimos ¹ , Sofia Tsitsou ¹ , Dionysia-Lydia Bothou ¹,
Stamatia Vitsou-Anastasiou ², Olga S. Papadopoulou ² , and Emilia Papakonstantinou ¹ 



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Abstract: Introduction: The purpose of this study was to test the hypothesis that a preload including orange fruit juice (FJ) enriched with 50 µg of vitamin D3, 8.33 g of n-3 PUFA, and 108 cfu/mL of *Lactocaseibacillus casei* Shirota and *Lactocaseibacillus rhamnosus* GG probiotics, consumed as a snack before a meal, would (a) have greater short-term effects on satiety, as measured by the subsequent *ad libitum* meal intake, and (b) induce greater satiety, as assessed using visual analogue scales (VAS), in normal-weight and overweight healthy individuals compared to the same orange FJ without any fortification. Methods: Forty-six healthy individuals (normal weight: $n = 24$, 25 ± 1 years, BMI: 21 ± 1 kg/m²; overweight: $n = 22$, 28 ± 2 years, BMI: 27 ± 1 kg/m²) participated in this randomized, double-blind, within-subject crossover study. The participants consumed a standardized breakfast after 12 h of fasting. Two hours later, they were given 50 g of available carbohydrates from the two preloads (enriched orange FJ or control FJ) in random order, with a one-week washout period, and three hours later, they were offered an *ad libitum* lunch. The participants rated their hunger, desire to eat, perceived fullness, thirst, preoccupation with food, and pleasure of eating on visual analogue scales (VAS) at the baseline and at 15–30 min intervals up to 7 h of the intervention. Results: A statistical analysis of the results showed that when the individuals consumed the preload that included the FJ enriched with biofunctional ingredients, they had lower feeling of hunger, desire to eat, and preoccupation with food, and a higher perceived fullness at all time points between the preload and the meal. Additionally, the overweight individuals had a lower total energy intake at the meal and a lower energy intake 24 h post intervention day, as well as lower protein and fat intakes, compared to the normal-weight individuals. Discussion: Since the macronutrient contents of both preloads were similar, the satiating power of the enriched FJ indicates that the added ingredients (vitamin D3, n-3, and probiotics) have biofunctional properties that induce fullness and reduce the total energy intake, particularly in overweight individuals. The addition of enriched FJ to a snack seems to promote satiety besides providing valuable nutrients, and it may be an effective strategy for body weight control.

Keywords: fruit juice; vitamin D3; n-3 fatty acids; probiotics; satiety

Author Contributions: E.P. conceptualized and designed the study, and drafted the manuscript. N.Z. conducted nutritional and statistical analyses, and drafted the manuscript. N.Z., C.A., S.T., D.-L.B. collected the data. S.V.-A. and O.S.P. created the fruit juices with the added biofunctional ingredients. All authors have read and agreed to the published version of the manuscript.

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Anti-Obesity Properties of a *Latilactobacillus sakei* Strain in *C. elegans* and Diet-Induced Obese Rats [†]

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Abstract: Introduction: In the last few years, several studies have described the beneficial effects of the supplementation of diets with certain probiotic strains and different obesity-related disturbances, including metabolic syndrome. New research lines aim to characterize and understand the strainspecific mechanisms of action and their effects on the host's health. The use of animal models is necessary to understand how probiotics interact with the gut microbiota and exert beneficial activities, which would allow us gain insight into potential new strategies against obesity-related diseases. Objective: we aim to characterize the effects of a novel probiotic strain of *Latilactobacillus sakei* (*L. sakei*) in two different animal models with adiposity excess. Methods: *Caenorhabditis elegans* was used as a starting in vivo model to analyse how the probiotics affect fat accumulation, oxidative stress, senescence, and lifespan when exposed to high-glucose conditions. Then, the effects of *L. sakei* oral administration (10⁹ CFU/day) were evaluated in diet-induced obese (DIO) Wistar rats, and biochemical, transcriptomic, metagenomics, and metabolomics analyses were performed. Results: Supplementation with *L. sakei* in *C. elegans* counteracted the deleterious effects of glucose by reducing fat accumulation, enhancing the oxidative stress response, and extending lifespan by directly regulating the carbohydrate- and lipid metabolism-related genes *acox-1*, *maoc-1*, and *daf16*. Following the same trend, DIO rats supplemented with *L. sakei* showed lower proportions of mesenteric and subcutaneous fat, improved glucose tolerance, and an ameliorated inflammatory marker profile, partly by regulating the expression levels of key metabolic genes like adiponectin, leptin, and *Acox1*. The oral administration of *L. sakei* modulated faecal microbiota composition and induced the production of novel plasma metabolites. Conclusions: our results unveil new strainspecific mechanisms of action through which *L. sakei* exerts health-promoting effects in *C. elegans* and DIO adiposity models, as well as further describe how these probiotics could potentially be useful for the prevention and treatment of metabolic syndrome-related diseases.

Keywords: microbiota; probiotics; obesity; lactic acid bacteria; inflammation; adiposity; insulin; metabolomics

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The Effects of L-Theanine Supplementation on Quality of Sleep: A Systematic Review [†]

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Abstract: Background/Objectives: Sleep disturbances are considered a major public health issue due to their negative impact on overall health and the economy. There is an increasing interest in plant bioactive compounds as natural alternatives to common pharmaceutical treatment options for improving sleep quality. The green tea amino acid, L-theanine (L-THE), has been shown to induce relaxation, reduce stress, anxiety, and depressive symptoms by influencing the several neurotransmitters associated with the sleep–wake cycle. Therefore, the aim of this systematic literature review was to evaluate the effects of L-THE consumption on sleep quality in humans. Methods: Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines, systematic literature searches were conducted in six electronic databases (PsycINFO, CINAHL, Web of Science, Medline, Scopus, and Cochrane Central Register of Controlled Trials). This systematic literature review was pre-registered with the international prospective register of systematic reviews PROSPERO (CRD42022304635). Results/Discussion: In total, eleven journal articles were identified that met the inclusion criteria where L-THE supplementation (alone or in combination with other bioactives) was compared to the supplementation of a placebo (or comparator) for the treatment of sleep disturbances. The duration of treatments varied from one day to eight weeks. The majority of the included studies were conducted in adults ($n = 373$) while two studies were completed in children ($n = 107$). Improvements in several sleep parameters were observed including sleep onset latency (7), total sleeping time (2), sleep duration (2), sleep efficiency (2), overall sleep quality (5), daytime dysfunction (2), early awakenings (1), morning sleepiness (3), the use of sleep medication (1), and sleep disturbances (4) (All p ’s < 0.05). The findings indicate that L-THE (50–655 mg) may be effective at improving sleep quality either as an individual supplement or in combination with other bioactives. Furthermore, the treatment of sleep disturbances with L-THE at doses higher than 655 mg may not be beneficial and may be detrimental to overall sleep quality. Conclusion: The findings of this systematic literature review indicate promising effects on the use of L-THE in the management of sleep disturbances and highlight the need for further studies to determine if there is an optimal concentration of L-THE for improving sleep.

Keywords: sleep; L-theanine; green tea; nutraceuticals

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The Effect of Betaine Supplementation on Crossfit Performance, Testosterone, and Inflammatory Cytokines [†]

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Abstract: Betaine (BET) is a natural substance found in a variety of foods. BET is also a popular ingredient in dietary supplements. Athletes and physically active people are among those most interested in supplementing BET, because of its beneficial effect on health and, hypothetically, sports performance. The aim of this study was to evaluate the effect of 3-week BET supplementation on Crossfit performance, muscular power, cytokines, and hormones concentrations in Crossfit-training males. The secondary aim was to compare two different BET doses (2.5 g/d and 5.0 g/d). The study was designed in a double-blinded randomized cross-over fashion. Forty-three participants completed the entire study. Crossfit performance was measured using the Fight Gone Bad (FGB) workout and muscle power was evaluated in a 30 s WAnT. Body composition was determined by air-displacement plethysmography. Blood was drawn in the morning of each of the four study meetings, when fasted. Total FGB improved with BET by $8.7 \pm 13.6\%$ ($p < 0.001$), but no significant changes were observed with the placebo ($-0.4 \pm 10.0\%$, $p = 0.128$). No changes were observed in WAnT and body composition with BET. After BET supplementation, testosterone concentrations increased by $7.0 \pm 15.4\%$ ($p = 0.046$) (no change with the placebo: $1.5 \pm 19.6\%$, $p = 0.884$) but no effect was observed for concentrations of insulin-like growth factor or cortisol. Our results show that BET supplementation significantly decreased homocysteine concentration (from $17.1 \pm 4.0 \mu\text{mol/L}$ before BET to $15.6 \pm 3.5 \mu\text{mol/L}$ after BET, $p = 0.009$, $\eta^2 = 0.164$), but had no effect on cytokines concentrations (IL-1 β , IL-6, and TNF- α). There was no significant interaction with BET dose for any measured outcome. In conclusion, 3-week BET supplementation may improve Crossfit performance, increase testosterone concentrations, and decrease homocysteine concentrations in training males. However, BET had no influence on anaerobic muscular power, body composition, and inflammatory status in our population. The application of our results might refer to males who want to improve their Crossfit performance, and also to populations with decreased testosterone levels, e.g., older males. However, further studies should determine the effect of BET in different populations. Key words: Wingate; Fight Gone Bad; body composition; betaine.

Keywords: betaine; testosterone; exercise; crossfit; cytokines



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Short-Term Effects of Fruit Juice Enriched with Vitamin D3, n-3 PUFA, and Probiotics on Glycemic and Insulinemic Responses: A Randomized Controlled Clinical Trial on Healthy Adults [†]

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Abstract: Introduction: The health benefits of eating fruits have been well established. Fruit juice is the product of the extraction or pressing of the natural liquid contained in fruits. The glycemic index (GI) is a tool developed to systematically classify carbohydrate-containing foods according to the time-integrated effects on postprandial glycemic responses. This study aimed to determine the effects of consuming a mixed commercial fruit juice (containing apples, oranges, grapes, and pomegranates) fortified either with two probiotic strains (*Lactobacillus casei* Shirota and *Lactobacillus rhamnosus* GG), or with vitamin D3, or with n-3 polyunsaturated fatty acids (PUFA), or with a combination of all of the aforementioned biofunctional ingredients versus the same control fruit juice without biofunctional ingredients on the postprandial glycemic and insulinemic responses. Methods: Eleven healthy, normal-weight volunteers (25–2 years; five females; BMI = 23 ± 1 kg/m²) participated in this randomized, double-blind, crossover clinical trial and were randomly assigned to receive five types of fruit juices (the fruit juice control, fruit juice with 50 µg vitamin D3, fruit juice with 8.33 g n-3 PUFA, fruit juice with 10⁸ cfu/mL probiotics, and fruit juice with vitamin D3, n-3

PUFA, and probiotics, all tested once) and D-glucose as a reference drink, which was tested two times. They all contained 50 g available carbohydrates, and the fruit juices were administered at different weeks in a random sequence according to the recommended glycemic index methodology. Capillary blood glucose and salivary insulin samples were collected at the baseline and for 180 min post consumption. Results: All the fruit juices provided low GI values (control: 54; vitamin D3: 52; n-3: 51; probiotics: 50; vitamin D3-n-3 PUFA-probiotics combination: 52, on the glucose scale). All the fruit juice types provided lower peak glucose values, smaller mean glycemic and insulinemic responses, and were more pleasurable than glucose was. Discussion: All the fruit juice types, regardless of the added biofunctional ingredients, attenuated the postprandial glycemic responses, which may offer advantages for glycemic control.

Keywords: fruit juice; glycemic responses; glucose; vitamin D3; n-3 PUFA; probiotics

Author Contributions: E.P. and C.C.T. conceptualized the study. E.P. designed the study and drafted the manuscript. N.Z. conducted nutritional analyses, including measurement of available carbohydrates and fibers, statistical analyses, and drafted the manuscript. N.Z. collected the data. C.A. measured salivary insulin concentrations; S.V.-A., and O.S.P. created the probiotic cultures to be added to the fruit juice; G.-J.N. served as a scientific counselor to this study. All authors have read and agreed to the published version of the manuscript.

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Demethoxycurcumin and Bisdemethoxycurcumin Are More Bioavailable than Curcumin: A Meta-Analysis of Randomized Cross-Over Trials in Healthy Humans and an In Vitro Mechanistic Exploration [†]

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Abstract: Background: Curcuminoids are secondary plant metabolites found in turmeric and many dietary supplements. They usually consist of a mixture of curcumin (CUR), demethoxycurcumin (dCUR) and bisdemethoxycurcumin (bdCUR). CUR, the main curcuminoid, has been intensely investigated for its putative effects against, e.g., inflammation, oxidative stress and cancer. However, CUR displays very poor bioavailability. We have previously shown that, when brought by turmeric, dCUR and bdCUR, which can also exert health effects, display greater in vitro bioaccessibility than CUR (PMID: 37073511). However, their bioavailability relative to that of CUR has not been thoroughly investigated. Objective: We aimed to compare the bioavailability of dCUR and bdCUR to that of CUR in a meta-analysis of clinical trials in healthy humans and to compare their in vitro bioaccessibility and enterocyte uptake efficiency. Methods and Results: Studies published until 2022 were searched for using Medline and Scopus. The included studies were randomized trials that measured the bioavailability of CUR, dCUR and bdCUR in healthy participants. Estimates were calculated using a random-effects model. Fifteen trials were included in the study, representing a total of 50 interventions, i.e., each trial investigated several curcuminoid formulations, in 762 participants. The relative bioavailabilities were calculated using the inverse variance method. dCUR was 2.32 (95% CI: 1.70, 3.13) times more bioavailable than CUR, while bdCUR was 2.57 (95% CI: 1.58, 4.16) times more bioavailable than CUR, with some heterogeneity across the formulations used. Using an in vitro gastro-intestinal digestion model with pure curcuminoids, we showed that dCUR solubilization efficiency was 4.8 and 5.3 times higher than that of CUR and bdCUR, respectively ($p < 0.001$), while its micellization efficiency was 10.3 and 5.1 times higher than that of CUR and bdCUR, respectively ($p < 0.001$). Conclusions: bdCUR and dCUR display greater bioavailability in humans compared to CUR. A subgroup analysis by formulation is undergoing investigation and will be presented. For dCUR, this difference is partly explained by higher in vitro bioaccessibility. Uptake efficiency measurements of pure curcuminoids and of curcuminoids from in vitro digestion fluids are undergoing investigation and will be presented. bdCUR and dCUR might therefore represent relevant alternatives to CUR for the systematic delivery of curcuminoids.

Keywords: curcuminoid; turmeric; bioaccessibility; enterocyte; cell uptake; stability; solubility; digestion; small intestine; absorption



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The Concentration of Iodine and Selenium in Fish Depends on the Type of Thermal Process [†]

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Abstract: Background and Objectives: Iodine and selenium are trace elements essential for health. In many countries, a deficiency of both minerals is common. Sea fish can be a good source of these minerals and their consumption should be increased. The objective of this research was to evaluate the effect of various thermal treatments of sprats and sardines on the concentration of total iodine, its iodide form (I⁻) and selenium. Material and Methods: Sprats and sardines were purchased from markets selling sea food. Sprats were caught in the Baltic Sea and sardines in the Mediterranean Sea. After removing inedible parts and washing, fish were thermally treated using the following processes: cooking, steaming, baking or frying. In freeze-dried samples, the concentrations of selenium and iodine were measured using the ICP-MS/MS method. For an analysis of iodide the form HPLCICP-MS/MS method was used. Data were statistically evaluated using two-way factorial analysis of variance (MNOVA), and Scheffe's test at significance level $p < 0.05$. Results: Iodine concentration was not affected by the type of fish. The lower losses of iodine were measured in samples of baked fish. The iodide form of iodine concentration was statistically different between sardines and sprats. In both cases, the best thermal processes to protect from iodide (I⁻) losses were cooking, steaming and baking. The highest concentration of selenium was measured in raw sardines and thermally treated ones, as compared to the raw and thermally treated sprats. Cooking, baking and steaming were the best processes for the protection of the concentration of selenium in both types of fish. Discussion: Sardines and sprats can be source of iodine in the diet, and especially a portion of 200 g of baked sardines or sprats can provide, respectively, 55 µg or 32 µg of iodine (39% or 20% of the recommended daily allowances [RDA] for adults); 100 g of baked or steamed sardines covers about 78% (48 µg/100 g f.m.) of the RDA for selenium. Steamed or baked sprats can cover the daily requirements to 54%. It can be suggested that the frequent consumption sprats and sardines can improve the intake of iodine and selenium.

Keywords: fish; thermal processes; iodine; selenium

Author Contributions: Conceptualization methodology, A.K., E.P. and S.S.; formal analysis, S.S., J.P., A.K. and J.S.; investigation, S.S., J.P. and A.K.; data curation, A.K., S.S., I.D. and T.L.; writing—original draft preparation, A.K. and E.P.; writing—review and editing, A.K., E.P., T.L. and I.D.; funding acquisition, A.K. and I.D. All authors have read and agreed to the published version of the manuscript.

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The Effects of Various Thermal Processes on the Antioxidant Status of Sprats and Sardines [†]

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Abstract: Background and objectives: Fish should be an important part of a properly balanced diet because of their nutritional value. Sprats and sardines are rich sources of protein, polyunsaturated fatty acids, especially n-3, and other nutrients. Unfortunately, fish consumption is too low among almost all European countries. The aim of this study was to evaluate the antioxidant activity of sprats and sardines subjected to thermal treatment: boiling, steaming, baking, and frying. Materials and methods: Samples of sprats and sardines were purchased from markets selling sea food. Based on the distributor information, the sprats were caught in the Baltic Sea and the sardines were caught in the Mediterranean Sea. After removing the inedible parts and washing the fish, the fish were cooked, steamed, baked, or fried. Thus, the prepared samples were freeze-dried. Next, a methanolic extract was prepared for an antioxidant activity analysis. The antioxidant activity was measured using the ABTS•+, DPPH as well as FRAP methods. Data were statistically evaluated using a two-way factorial analysis of variance (MNOVA), and Scheffe's post hoc analyses with a significance level of $\alpha = 0.05$. Results: The higher antioxidant activity measured with the ABTS method was determined in raw sprats as compared to thermally treated both types of fish. The highest antioxidant activity measured with the ABTS method was found in the steamed and baked sprats as compared to other samples of fish. The fried and baked sardines had the highest antioxidant activity measured via the FRAP method. The raw sprats and the raw and fried sardines had the highest antioxidant activity measured with the DPPH method. Discussion: Based on these obtained results, it can be suggested that generally, sprats have better antioxidant activity than sardines. This can be explained by the different living conditions that affect the content of various antioxidant compounds. Furthermore, the type of thermal treatment used for the sprats and sardines can strongly affect their antioxidant activity. Using traditional cooking methods that cause compounds soluble in water to be removed from food products can also affect the antioxidant activity of fish. Steaming and baking are processes in which the antioxidant activity became higher.

Keywords: fish; antioxidant activity; thermal processes

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Higher Vitamin D2 and 25(OH)D2, but Not Vitamin D3 Metabolites, in Bovine Plasma and Muscle from Grass-Based Finishing System, Compared to Concentrate [†]

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Abstract: Meat and meat products are one of the largest contributors to vitamin D dietary intakes. Little is known, however, about how different animal husbandry practices and/or finishing diets might affect the vitamin D content of the animal. Therefore, this study aimed to investigate the effect of bovine finishing diet (grass vs. concentrate) on the 25(OH)D plasma concentrations of cattle and subsequent vitamin D content in beef. Cattle were fed grass (n = 7) or concentrate (n = 9) finishing diets for 15 weeks prior to slaughter. Bovine blood samples were collected at slaughter and plasma aliquots were stored (−80 °C) until analysis. Beef top rump from each animal was chilled for an ageing period of 21 days, then homogenised and frozen (−80 °C) until analysis. Bovine plasma samples were analysed for circulating 25(OH)D3, and 25(OH)D2 (nmol/L), and raw beef muscle (top rump) samples were analysed for vitamin D metabolites; vitamin D3, vitamin D2, 25(OH)D3 and 25(OH)D2 (µg/kg), all by LC-MS/MS. Total vitamin D activity was defined: [vitamin D3 + (25(OH)D3 × 5) + vitamin D2 + (25(OH)D2 × 5)]. Statistical analysis was conducted by SPSS with independent *t* tests used to compare groups; significance level *p* < 0.05. Data were presented as mean ± SD. A significantly higher plasma 25(OH)D2 concentration was observed in the grass finished cattle compared to the concentrate group (43.18 ± 11.75 vs. 16.56 ± 1.58 nmol/L, *p* < 0.002). No difference in plasma 25(OH)D3 concentrations was observed between groups. In beef top rump, the grass finishing diet resulted in a significantly higher mean ± SD vitamin D2 [0.07 ± 0.05 vs. 0.01 ±

0.01 µg/kg] and 25(OH)D2 [0.70 ± 0.16 vs. 0.25 ± 0.07 µg/kg] compared to concentrate finishing diet (both *p* < 0.001). Moreover, beef from grass finished cattle demonstrated a significantly higher total vitamin D activity compared to those in the concentrate group [9.52 ± 2.43 vs. 6.78 ± 2.00 µg/kg, *p* < 0.05]. No difference was observed for muscle vitamin D3 or 25(OH)D3 between groups. In conclusion, a more favourable bovine vitamin D profile, driven by vitamin D2 metabolites specifically (not vitamin D3), is reported from a grass-based finished system, compared to concentrate finishing. Further research is required to understand the impact of these findings for both agriculture practices and human nutrition.

Keywords: vitamin D2; 25(OH)D2; beef; Grass-based finishing system

Author Contributions: Conceptualization, K.P. and R.P.; methodology, E.R. and C.M.; formal analysis, E.R.; resources, C.M. and M.M.; data curation, E.R.; writing—original draft preparation, E.R.; writing—review and editing, E.R., C.M., R.P., S.S., M.M. and K.P.; supervision, K.P.; project administration, M.M.; funding acquisition, R.P., S.S. and M.M. All authors have read and agreed to the published version of the manuscript.

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Fruit Wine and Its Biologically Active Compounds' Ability in Health Prevention [†]

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Abstract: Background and objectives: Blackberry is one of the most important berry fruits growing in Serbia. Crops and derived products are rich sources of many natural active compounds, which possess beneficial health effects. In particular, it is possible to point out the role of blackberry and its derived products in hyperglycemia prevention since it is a very common problem among the general population today. Blackberry wine is a product which could have significant beneficial health effects during moderate consumption. The aim of this study was to investigate the α -glucosidase inhibitory activity of blackberry wine and the contribution of some natural compounds to this activity. Methods: Fruit wines were produced through microvinification during controlled fermentation by using pure yeast strain culture. Samples were lyophilized and dissolved in DMSO. The inhibition of α -glucosidase was evaluated by using α -glucosidase and substrate solution, p-nitrophenyl α -Dglucopyranoside. The identification and quantification of some natural compounds was conducted by using UPLC TQ-MS/MS. Results: After lyophilization of the produced blackberry wine, all of the determinations were conducted in four samples. The results for the α -glucosidase inhibitory activity were in the range of 31.5–55.7 μ g/mL. The control showed acarbose whit inhibitory activity of 75.3 μ g/mL. Moreover, the estimated amount of epicatehin, catehin, chlorogenic, ellagic, and gallic acids and their contribution to the α -glucosidase inhibitory activity of the sample was from 1.7% to 7.7%. Discussion: The obtained results show that blackberry wine is a good inhibitor of α -glucosidase compared to acarbose. The presence of phenolic compounds in wine is due to its extraction from the skin and seeds of blackberry during alcoholic fermentation. Ethanol, which naturally occurs in wine, has a key role in this process. Fruit wine can be considered as a potential functional food. α -glucosidase activity depends on the synergistic and antagonistic effect of natural active compounds in fruit wine.

Keywords: blackberry wine; α -glucosidase inhibition; phenolic compounds

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Sensory Evaluation of Prototypes of Novel Dishes and Recipes Based on Underutilized Foods [†]

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Abstract: Background and objectives: Since the beginning of the 20th century, more than 75% of genetic diversity has been lost. As a result of this homogenization, thousands of cultivated and wild food plants are no longer used, although they have high nutritional value. This work aims to develop recipes for new dishes and bring biodiversity to the plate in a way that consumers desire. Methods: Prototypes of new foods were prepared in the experimental kitchen. Each recipe was blind-tasted, evaluated, and ranked according to its organoleptic quality using a systematic approach. Both independent professional taste experts and lay public representatives were involved in the sensory evaluation of dishes. After the initial sensory evaluation (discrimination and hedonic scoring tests) in Serbia, the following recipes were selected for further evaluation in four other countries—Greece,

Hungary, France, and Turkey: Dandelion and Tomato Salad; Buckwheat and Grass Pea Stew with

Eggplant; Baked Eggplant and Potato à la Papa Alexie; Lentils as a Starter and Buckwheat Pockets Filled with Walnuts and Dried Fruit. The recipes were tested by 132 lay public representatives and

24 professionals. Results and Discussion: Of the five dishes tested, Buckwheat Pockets Filled with Walnuts

and Dried Fruit were the most popular, followed by Baked Eggplant and Potato à la Papa

Alexie and Dandelion and Tomato Salad. Although cultural differences and individual preferences play a role, none of the dishes was considered unacceptable or undesirable, and most were rated as likable to very

likable. In line with the feedback, the optimization of the recipe design was discussed to optimize the sensory perception of the new dishes and to achieve a stimulating and satisfying taste and smell with appropriate texture and mouthfeel. The sensory evaluation showed that the new dishes offered, based on the underutilized foods studied in this project, were highly recognized and well received by consumers.

Finally, a recipe book was created that includes a detailed explanation of the preparation methods and a comprehensive presentation of the relevant nutritional information of the new food dishes.

Keywords: underutilized foods; sensory evaluation; new dishes; hedonic scoring test; Buckwheat; Dandelion; Grass Pea; Eggplant; Lentils



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Grape Seed Powders as a Source of Phenolic Compounds: UHPLC Orbitrap MS4 Characterization [†]

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Abstract: Grape seeds represent a rich source of phenolic compounds that exhibit various health benefits. Therefore, grape seed powders can be a potential functional ingredient in the formulation of different nutritionally valuable food products. The aim of this study was the UHPLC Orbitrap MS4 characterization of phenolic compounds and their derivatives in indigenous (Smederevka, Tamjanika, and Prokupac) and international (Italien Riesling, Muscat Hamburg, Merlot, and Cabernet Sauvignon) grape seed powders. Phenolic compounds were extracted from grape seed powders with 80% methanol containing 0.1% HCl and analyzed by UHPLC Orbitrap MS. The identification of phenolic compounds was conducted based on their monoisotopic mass, MS fragmentation (MS4, MS3, MS2), available standards and literature data. Using standards, gallic, protocatechinic, p-hydroxybenzoic, and vanillic acids were identified in the seed extracts of all analyzed grape varieties. On the other hand, gentisic acid was not detected in the seed extracts of the Smederevka and Merlot varieties. Other phenolic acids and their derivatives, such as ellagic acid (300 m/z), gallic acid hexoside

(331 m/z), dihydroxybenzoic acid hexoside (315 m/z), caffeoyl tartaric acid (311 m/z), and coumaroyl tartaric acid (295 m/z), were identified in all analyzed seed extracts based on exact mass and MS2 fragmentation. Commonly present flavan-3-ols (catechin, epicatechin, and catechin gallate) and different B-type procyanidins (B-type procyanidin dimer, trimer, and gallate isomers) were also identified in all analyzed samples. To the best of our knowledge, the procyanidin profiles of the indigenous variety Tamjanika (eight compounds) were analyzed for the first time. Flavonol aglycones (taxifolin and quercetin) and glycosides (quercetin, isorhamnetin, and kaempferol glycosides) were also identified, but their presence in the seeds was selective and closely dependent on grape varieties. In sum, grape seed powders of indigenous and international varieties contain different classes of phenolic compounds, primarily flavan-3-ols, procyanidins, and phenolic acids, which increase and favor their future application in the food industry.

Keywords: UHPLC Orbitrap MS; seed; phenolic compounds; procyanidins; indigenous grape variety



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Grape Pomace Seed and Skin Powder as a Source of Dietary Fibre [†]

Danijel Milincić¹ , Bojana Vidović^{2,*} , Sladana Stanojević¹  and Mirjana Pešić¹ 



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Abstract: Dietary fibre intake is associated with various health benefits, such as glucose absorption regulation, blood cholesterol level reduction, and the prevention of obesity and cardiovascular diseases. Grape pomace and its constituents (seed and skin) present a good source of dietary fibre. They can be used as gelling or binding water agents. However, they are mostly incorporated into various food products as an integral part of milled pomace flour and powder, contributing to their functional, nutritional, physicochemical, textural, and sensory properties. This study aims to determine the content of dietary fibres in the seven different unfermented pomace seed and skin flours of international (Italian Riesling, Muscat Hamburg, Merlot, Cabernet Sauvignon) and indigenous (Smederevka, Tamjanika, Prokupac) grape varieties. The content of total (TDF), soluble (SDF), and insoluble (ISDF) dietary fibres in seed and skin flours were determined by the enzyme gravimetric method. The results showed that the content of TDF was almost three times higher in seed flour than in skin flour for all analyzed varieties. Seed flour had more ISDF (66.30–74.18%) and TDF (69.89–75.42%) and less SDF (0.89–4.27%) in comparison to the skin flour. The highest content of ISDF was confirmed in the seed and skin flour of the Cabernet Sauvignon variety. On the other hand, the highest content of SDF was determined in the skin of Italian Riesling and seeds of Smederevka varieties. Although there are differences in content, the seed and skin flour of all analyzed international and indigenous varieties represent a good source of dietary fibre and can be applied to formulate functional and nutritionally valuable food products. To the best of our knowledge, this is the first report on dietary fibre in the seed and skin flour of the autochthonous Prokupac and Tamjanika varieties.

Keywords: grape pomace; seed flour; skin flour; insoluble fibre; soluble fibre

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Phenolics and Flavonoid Content in Selected Seeds from the Serbian Market †

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Abstract: Objectives: Edible seeds are usually consumed as common food ingredients. They are considered to have a rich nutrient profile, containing different macro and micronutrients, as well as some biologically active compounds with positive health effects, such as different phenolics. The aim of this work was to determine total phenolics (TPC) and total flavonoid content (TFC) in selected commercial seeds samples from the Serbian market. Methods: Samples of nine seeds were investigated (sesame and black sesame, raw and roasted sunflower, raw and roasted pumpkin, hemp, chia and linseed). The samples of native seeds and those defatted using dichloromethane (maceration and Soxhlet extraction) were extracted with 80% methanol. Obtained hydro-methanol extracts were dried and further analysed using spectrophotometric methods: TPC was determined using Folin–Ciocalteu (FC) reagent and expressed as gallic acid equivalents (GAE), while TFC was measured based on the reaction between flavonoids and aluminium chloride and expressed as catechin equivalents (KE). Results: In general, hydro-methanol extracts of seed samples defatted using Soxhlet extraction had the highest TPC and TFC contents. TPC values ranged from 9.47 g GAE/mg (raw pumpkin seed) to over 170 g GAE/mg (raw sunflower seeds). As for TFC, the highest amount was measured in extracts of defatted raw sunflower seeds (over 150 g KE/mg), while roasted pumpkin and hemp seeds' extracts were practically devoid of flavonoids. Conclusion: Our results confirmed the fact that certain defatted seeds, which are usually considered as waste products in oil production, could be considered as valuable sources of certain secondary plant metabolites, implicating further investigations on their composition and potential in the development of functional foods.

Keywords: seeds; phenolics; flavonoids

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Medical Health Hazards in the Production of Meat and Meat Products [†]

Tsvetelina Vitkova * , Vanya Boycheva (Birdanova) and Rositsa Enikova



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objective: In today's society, meat and meat products occupy a relatively large share in terms

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of volume of production and have a serious epidemic potential as a source of disease. Both primary and secondary contamination with microorganisms are possible and, if any deviation in the technological process, the standardization of physico-chemical and microbiological indicators can lead to serious consequences for the health of consumers. The purpose of this study is to assess and analyze the likely medical and health hazards arising from the production, supply and consumption of meat and meat products. Methods: The object of the study is an enterprise for the production of meat and meat products in the territory of the Pleven region. For this purpose, an audit was carried out, based on an algorithm built by us, which corresponds to and is based on the Codex Alimentarius methodology, presented in the document “Food Quality and Safety Systems—A Training Manual on Food Hygiene and the Hazard Analysis and Critical Control Point (HACCP) System”. Results and discussion: Gaps and inconsistencies were found in the technological documentation, as well as in the HACCP plan in the normalization of the physicochemical characteristics and the criteria for microbiological safety. These could lead to potential risks and health hazards for consumers of meat and meat products. Quality requirements for meat products should include added soy protein, upper limits of fat content, connective tissue proteins, as well as types and concentrations of added additives. In the developed food safety systems, it is necessary to introduce a total number of mesophilic and psychrotrophic aerobic bacteria, Enterobacteriaceae, molds and yeasts, in order to verify the elements that represent the main hazards in the food chain. The conclusions contain specific recommendations for revising the technological documentation and the HACCP system and regulations for optimizing the microbiological requirements with the inclusion of integral indicators of production process hygiene.

Keywords: meat; HACCP plan; microbiological safety

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In-Depth Analysis of Edible Yeast-Based Protein Digestion in Humans Using the Dynamic In Vitro TIM-1 Model †

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Abstract: The global protein demand is constantly on the increase, requiring sustainable and healthier protein alternatives for animal and human nutrition. Yeast-based proteins (YBPs) represent a non-negligible environmentally friendly fermentation-based solution with high nutritional quality and bioavailability. Although in vitro studies cannot reflect the full complexity of in vivo digestion, they are considered a useful alternative to animal models in assessing protein digestibility. Herein, TIM-1 (TNO gastro-intestinal model) was used to assess the digestibility profile of a proprietary edible YBP according to INFOGEST guidelines. We characterized the YBP's digestibility and amino acid bio-accessibility and compared the YBP with milk-based references (casein and whey proteins). Each treatment was evaluated in triplicate during 5 h of digestion with hourly collection from jejunum and ileum compartments and final residual stomachal samples. Total nitrogen and free amino acid (FAA) were quantified. Size-exclusion chromatography and SDS-PAGE were also applied to assess the fate of protein hydrolysis over time. This study showed that all proteins were fully hydrolyzed upon one hour of digestion. YBPs were as good as milk-based references in terms of digestibility and small intestine absorption, reaching up to 60% of total bio-accessible protein after 5 h. Noteworthy, total YBP absorption followed a kinetics closer to that of whey protein in jejunum and ileum compartments. Our results are in line with a previous in vivo evaluation of YBPs where fecal N digestibility, PDCAAS, and DIAAS were evaluated. Altogether, our results suggest that YBPs could be a nutritionally relevant animal protein alternative.

Keywords: yeast-based proteins; in vitro digestibility; amino-acids

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Mercury Content in Fish Oil Food Supplements and Associated Health Risk [†]

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Abstract: The market for fish oil supplements is growing significantly, as fish oil is one of the bestknown sources of beneficial long-chain polyunsaturated fatty acids. However, along with the potent health benefits, first of all regarding the reduction of cardiovascular disease risk, the consumption of fish oil could also pose a potential health risk. Namely, fish positioned higher in the food chain, such as shark, swordfish, tuna, mackerel, etc., are known to bioaccumulate mercury. Indeed, consumption of fish is the main source of mercury exposure for humans, specifically of the most toxic form of mercury, methylmercury (MeHg). In the human organism, MeHg manifests a wide spectrum of adverse health effects, collectively known as Minamata disease. The objective of this study was to assess the health risk of mercury exposure through fish oil supplement consumption. The total mercury content of 42 fish oil supplements available on the markets of the Republic of Serbia and the Republic of Srpska was determined by a direct mercury analyzer. A risk assessment was conducted for the adult population, taking into account the recommended intake of supplements and the toxicological profile of MeHg: an oral reference dose (RfD) of 0.0001 mg/kg bw/day and a tolerable weekly intake (TWI) of 0.0013 mg/kg bw. Since MeHg accounts for up to 75–98% of the total mercury content in fish, the precautionary principle was applied, meaning that the total mercury content was considered equal to MeHg. The total mercury content in supplements ranged from 0.001 to

0.0057 mg/kg, which is far below the maximum level for food supplements of 0.1 mg/kg. The mean (\pm standard deviation) of mercury content was 0.0019 ± 0.0009 mg/kg. The corresponding consumer mean exposure was $0.042 \pm 0.039\%$ of the RfD, with a maximum at 0.24%, and in the case of TWI, $0.023 \pm 0.021\%$, with a maximum at 0.13%. Thus, the risk from mercury in fish oil supplements was negligible, even for pregnant and nursing women who need to protect their children from the extremely harmful developmental neurotoxicity of MeHg. However, the presence of other lipophilic environmental pollutants, such as polychlorinated biphenyls, dibenzodioxins, and dibenzofurans, should be investigated.

Keywords: mercury; fish oil; food supplement

Author Contributions: Conceptualization, L.T.; methodology, L.T.; formal analysis, J.B.F. and L.T.; investigation, N.S. and D.L.; data curation, M.D.; writing—original draft preparation, L.T. and J.B.F.; writing—review and editing, L.T.; project administration, L.T.; funding acquisition, L.T. All authors have read and agreed to the published version of the manuscript.

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The Impact of Malted Grains on Human Intestinal Microbiota Composition in an In Vitro Model[†]

Carlos Gómez-Gallego^{*}, Roosa-Maria Willman, Kati Martikainen and Marjukka Kolehmainen^{}



Citation: Gómez-Gallego, C.; Willman, R.-M.; Martikainen, K.; Kolehmainen, M. The Impact of Malted Grains on Human Intestinal Microbiota Composition in an In Vitro Model. *Proceedings* **2023**, *91*, 362. <https://doi.org/10.3390/proceedings2023091362>

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Abstract: Background and Objectives: Malting barley

(*Hordeum vulgare*) and wheat (*Triticum aestivum*) grains offer various nutritional benefits through controlled germination processes, including an increased fiber content, improved mineral bioavailability, higher levels of vitamins and antioxidants, and enhanced protein digestibility. However, the specific impact of malting on the intestinal microbiota remains unknown. Given the potential of malted grains to enhance fiber content and because they contain beneficial compounds like prebiotics, it is reasonable to speculate that the consumption of malted barley and wheat could positively influence the intestinal microbiota by promoting the growth of beneficial bacteria and supporting a healthy gut environment. **Methods:** Raw and malted barley and wheat grains were subjected to in vitro gastric and intestinal digestion using the INFOGEST method. After gastrointestinal digestion, samples were centrifuged, and the undigested pellet and 10% of the supernatant were introduced into a bioreactor that mimicked the proximal colon's environmental conditions. The bioreactor was inoculated with human fecal microbiota pooled from six healthy human donors to simulate colonic fermentation. Samples were collected at 0, 6, and 24 h, and DNA was extracted. Whole variable region sequencing using PacBio technology was performed for 16S sequencing. **Results:** In our in vitro system, malting did not significantly impact microbiota alpha diversity (Shannon index and richness) or beta diversity. The colonic fermentation of malted barley was characterized by a higher relative abundance of *Enterococcus faecalis* ($p = 0.02$), *Weissella cibaria* ($p = 0.04$), and the *Ruminococcus gnavus* group ($p < 0.05$). When comparing malted and non-malted wheat, non-malted wheat fermentation showed a higher relative abundance of *Lactobacillus gasseri* ($p = 0.05$) and lower levels of *Bacteroides* sp. ($p < 0.05$). **Discussion:** Based on our results, malting has a minimal impact on microbiota composition in vitro. However, considering the changes in nutrients and bioactive compounds, alterations to the microbiota activity may be more substantial. Future analyses using metagenomic sequencing or metabolomics profiling could provide valuable insights into the impact of malting on the functional activity of the microbiota. In vivo studies will be necessary to assess whether the consumption of malted grains over extended periods can have a more significant impact on the intestinal microbiota.

Keywords: malting; cereals; microbiome; colonic fermentation; *Lactobacillus*

Author Contributions: Conceptualization, C.G.-G. and M.K.; methodology, C.G.-G. and R.-M.W.; formal analysis, R.-M.W. and K.M.; investigation, C.G.-G., R.-M.W. and K.M.; resources, M.K.; data curation, C.G.-G. and K.M.; writing—original draft preparation, C.G.-G. and M.K.; writing—review and editing C.G.-G., R.-M.W., K.M. and M.K.; visualization, C.G.-G. and M.K.; supervision, C.G.-G. and M.K.; project administration, C.G.-G. and M.K.; funding acquisition, M.K. All authors have read and agreed to the published version of the manuscript.

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Comparative Advantages of Fatty Acid Composition and Nutritional Indices of Specific Edible Plant Oils †

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Abstract: A variety of specific plant oils produced from plants other than sunflowers and olives has been offered on the food market, most of them obtained using cold pressing in order to preserve sensitive oil components. The objective of this study was to evaluate their fatty acid (FA) compositions by means of nutritional quality indices. FA profiles (37 FAs) of 20 commercially available specific edible plant oils were obtained using GC-FID and further evaluated by calculating lipid quality indices. FA profiles and their corresponding quality indices showed the expected variability, depending on the plant source. For the purpose of comparison, the same indices were determined for sunflower and olive oil: the polyunsaturated-to-saturated FA ratio (PUFA/SFA) was 5.1 and 0.5, the hypocholesterolemic/hypercholesterolemic ratio (HH) was 13.0 and 6.8, the index of atherogenicity (IA) was 0.08 and 0.14, the index of thrombogenicity (IT) was 0.23 and 0.24, and the unsaturation index (UI) was 146.6 and 93.5, respectively. A higher PUFA/SFA ratio is beneficial for cardiovascular health, as are a lower IA and IT. The UI indicates stability of unsaturated FAs during storage and processing. Flaxseed oil was the only one showing a PUFA/SFA ratio higher than sunflower oil (5.8). Regarding IA, flaxseed, almond, apricot, plum, hazelnut, macadamia, and sea buckthorn oils were similar to sunflower oil; sesame, black cumin, poppy, pumpkin, avocado, raspberry seed, argan, moringa, and rose seed oils resembled olive oil; and palm oil was isolated at 0.80, while coconut oil reached 23.4. Flaxseed, almond, apricot, plum, raspberry seed, macadamia, rose seed, and sea buckthorn oils showed a lower IT than sunflower and olive oils (range 0.06–0.18). Coconut and palm oils showed lower HH ratios than olive oil, whereas, in the case of flaxseed, almond, apricot, plum, hazelnut, and sea buckthorn oils, this ratio was higher than the one in sunflower oil (range 14.0–16.1). Flaxseed oil was characterized by the highest UI (208.4), while others were distributed along the 90–170 interval (except coconut and palm oils). According to their nutritional quality indices, a variety of plant oils are valuable sources of FAs in human nutrition.

Keywords: plant oil; quality index; fatty acid



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Total SO₂ Content and Health Risks Associated with Serbian Orange Wines [†]

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Abstract: Orange wine is a wine obtained via the vinification of white grapes in a similar way to making red wine, so the fermenting juice spends time macerating in contact with the grape skins, affecting the color and structure of the final wine. Sulfur dioxide (SO₂) is the primary preservative used in wine. At wine pH, the most abundant forms are molecular SO₂, responsible for the antioxidant and antimicrobial effects, and bisulfite. This study was conducted to determine the levels of total SO₂ in orange wines marketed in Serbia and to assess the risk of SO₂ exposure through wines. Twentyfour orange wines were subjected to the volumetric analysis of total SO₂. Health risks were assessed taking into account wine consumption regarding the population average, for regular drinkers only and chronic heavy drinkers, according to the World Health Organization data, as well as the Serbian Food Consumption Survey. The content of total SO₂ varied from 10.8 to 79.4 mg/kg, and there were no products exceeding 200 mg/kg, which is the regulated level in Serbia. A risk assessment was conducted according to the position of the European Food Safety Authority that the available toxicity database was inadequate to derive a group acceptable daily intake (the previous temporary ADI was 70 mg SO₂ equivalents/kg bw per day) and that a margin of exposure (MOE) approach should be used instead. The MOE was calculated as the ratio of a lower confidence limit of the benchmark dose of 38 mg SO₂ equivalents/kg bw per day, which was based on prolonged visual evoked potential latency, and used to estimate the exposure of men, women and both sexes. The resulting MOEs, evaluated by applying an assessment factor of 80, indicated no risk concern in any of the exposure scenarios. Minimum MOE values were obtained for males in the consumers-only scenario (1061 and 357 for the mean and high (last quartile mean) exposure levels, respectively). Although encouraging, the findings of this study should be interpreted considering that SO₂ could be used in various food products and that only an aggregate exposure (accounting for all exposure sources) could fully reveal the associated health risks.

Keywords: food safety; food additives; margin of exposure; risk assessment

Author Contributions: Conceptualization, I.B. and L.T.; methodology, S.P.; formal analysis, L.T.; investigation, S.P.; data curation, T.M. and L.M.; writing—original draft preparation, I.B. and L.T.; writing—review and editing, L.T. All authors have read and agreed to the published version of the manuscript.

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Gluten in Beers: Evaluation of Reproducibility of the R5-Based Competitive Enzyme-Linked Immunosorbent Assay Method Using Real Samples [†]

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Abstract: Beer is the most widely consumed alcoholic beverage in Europe. In many occasions, its consumption is linked to social relations and a fruitive use. To comply with this, the market should offer gluten-free beers that are safe to be consumed by people with celiac disease or those who need to avoid gluten. Brewing hydrolyzes gluten, and this compels the analytical determination of this hydrolyzed protein to be carried out using a competitive ELISA method. The most commonly used competitive ELISA for this purpose is based on the R5 antibody, which has some disadvantages, such as less robustness compared to the homologous sandwich ELISA. The aim of this study was to evaluate the reproducibility of the R5-based competitive ELISA through detecting gluten in beers that intended to achieve a gluten-free label. Thirty-seven samples of beers in which gluten was detected (range 10–80 mg/kg gluten) were analyzed under intermediate precision conditions (e.g., different days and different analysts). Each sample was analyzed 3–20 times. A total of 185 tests were performed and statistically analyzed. The mean calculation of the relative standard deviation (RSD) has a median of 13.6% (range 2.1–23.4%). The samples were pooled according to their gluten content (expressed as mg/kg or ppm gluten) and the median for each interval as follows: beers containing 10–20 ppm (n = 9): RSD 16.1% (range 2.7–19.9%); 21–40 ppm (n = 20): RSD 12.7% (range 2.8–21.5%); and 41–140 ppm (n = 8): RSD 13.7% (range 2.1–23.4%). The main variability in precision was found in the samples with a low gluten content, close to the limit of quantification. This could be due to the fact that small differences in the measured absorbances in this range make a significant difference in quantification. Our results suggest that the precision of the assayed method in our laboratory was satisfactory, in line with the expectable results of other ELISA methods. An internal reproducibility of 20% could be a reliable limit for any testing laboratory. Without evaluating other factors such as accuracy, the data findings point to an elevated uncertainty value for this analytical method.

Keywords: gluten analysis; beers; reproducibility

Author Contributions: M.B., J.M. and E.S. conceived and designed the study; M.d.P.F.-G. and J.E. participated in the recruitment and analysis of the samples; M.d.P.F.-G., M.B. and J.M. collected and revised the data; O.M. and E.S. contributed in statistical analysis; E.S. drafted the manuscript. All authors have read and agreed to the published version of the manuscript.

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An Evaluation of the Possibility of Using Buckwheat Hulls as an Addition to Bread [†]

Joanna Maria Klepacka *  and Marta Czarnowska-Kujawska 



Buckwheat Hulls as an Addition to Bread. *Proceedings* 2023, 91, 347. <https://doi.org/10.3390/proceedings2023091347>

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nutritional value of buckwheat hulls, which can be a great source of fibre, phenolics, minerals and some vitamins, the aim of the study was to assess the possibility of using it as a functional addition in bread production. **Methods:** A recipe for baking wheat–rye bread with various additions of buckwheat hull was developed, and then a semi-consumer evaluation of bread baked in the same conditions (180 °C, 60 min) was conducted. The test material consisted of a control bread (without the addition of husk), bread with 10 and 20% husk (mixed with flour at the stage of dough preparation), and bread with a surface sprinkled with buckwheat husk (25 g) before baking. The semi-consumer evaluation involved 33 pre-trained persons who determined the degree of acceptance (desirability) of the selected bread's sensory characteristics (colour, texture, smell and taste) using the nine-point hedonic scale. **Results and discussion:** It was shown that all types of bread with the addition of buckwheat hulls were positively rated by evaluators, although the highest ratings were obtained for bread with the sprinkled surface. This bread scored higher than the control sample for all tested sensory characteristics, and the terms “I like it very much” in relation to its colour, texture, smell and taste were used by 80%, 77%, 76% and 70% of the respondents, respectively (for the control sample, such terms were provided by 73%, 73%, 53% and 60% of evaluators, respectively). The bread with the addition of buckwheat hulls to the crumb received lower, though still quite high, scores for smell and taste. These features were described as “very liked” by 57% and 40% of evaluators when assessing the bread with a 10% husk addition, and by 54% and 60% evaluators when assessing the bread with 20% husk addition. The lower rates for texture in these samples resulted from their poorer elasticity and softness, which may result from the reduction of the structure-forming effect of gluten by the introduction of gluten-free proteins derived from buckwheat hulls. **Conclusions:** Buckwheat hulls can be used as an additive that increases the nutritional value of bread, and the best way to add it, considering the sensory properties of bread, is to sprinkle it on its surface.

Abstract: Background and objectives: Buckwheat groat is a product that is eagerly consumed in many countries around the world, and its production consists primarily of the hydrothermal treatment (e.g., steaming, roasting, drying) and dehulling of buckwheat seeds. During this process, a large amount of buckwheat hull is obtained, which is treated primarily as a by-product and used mainly for non-food purposes. Due to the high

Keywords: buckwheat hull; nutritional value; bread; sensory properties

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In Search of Biological Activity of Orange Wines: Polyphenolic Profile and In Vitro Inhibition of Digestive Enzymes [†]

Ivana Beara ^{1,*} , Tatjana Majkic ¹, Ljiljana Milovanovic ¹ and Ljilja Torovic ²



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Orange wine, a traditional Georgian winemaker's product, has recently received outstanding global interest from both winemakers and wine lovers. Orange wines are made from white grape varieties through prolonged contact of the skin and seeds in the fermentation process, which is actually a technique for producing red wines. It is well known that wine polyphenols have certain biological activity and, therefore, can contribute to the health benefits of moderate (red) wine consumption. But, data on chemical composition and bioactivity of orange wines are scarce. Thus, we collected 24 Serbian orange wines present at a market in 2022. The analyses of seven phenolic acids, six flavonoids, two stilbenes, fifteen anthocyanin glucosides, galactosides and arabinosides using HPLC-UV/VIS techniques was applied to elucidate differences in samples' polyphenolic profiles. α -Amylase, α -glucosidase and lipase in vitro inhibition activities were evaluated using spectrophotometry. The most abundant polyphenols in the examined samples were gallic acid (0–49.5 mg/L), caffeic acid (0–22.2 mg/L) and catechin (0–76.7 mg/L). Piceid was detected in some samples (0.1–0.3 mg/L), while only five samples had a sporadic, low content of several anthocyanins. Principal component analyses (PCA) showed grouping of most of the samples in the central part, while sample 19 (produced in a north-Serbian winery) was obviously distinguished, mostly due to its highest content of gallic acid and catechin. The discriminating power was lower than 1.0 for all polyphenols. The analyzed orange wines had considerable hypoglycemic potential: activity ranged from 0.2 to 5.9 and 0.1 to 433 mg acarbose eq/mL of wine for α -amylase and α -glucosidase, respectively. Lipase inhibition was also notable: 7–43 ng orlistat eq/mL of wine. Direct correlation between expressed activity and determined polyphenols was not found, but PCA revealed samples 10, 16, 18 and 24 as the wines with the most prominent digestive-enzymes-inhibition activity. The presented results are just a part of our intensive research on the bioactivity of orange wines. Overall, our results should elucidate the possibility of health benefits of moderate consumption of orange wines, but also to contribute, at least partially, to the increase in recognition of Serbian orange wines in the domestic and global market.

Keywords: orange wine; polyphenols; bioactivity of wines

Author Contributions: Conceptualization, I.B. and L.T.; methodology, I.B., L.T. and T.M.; formal analysis, L.T., T.M. and L.M.; investigation, L.T., T.M. and L.M.; data curation, T.M. and L.M.; writing—original draft preparation, I.B. and L.T.; writing—review and editing, L.T. All authors have read and agreed to the published version of the manuscript.

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Prediction of the Potential of Food Proteins as Sources of Biopeptides Using BIOPEP-UWM Database [†]

Anna Iwaniak ^{*} , Małgorzata Darewicz and Piotr Minkiewicz



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3.4.15.1), dipeptidyl peptidase IV (DPP4; EC 3.4.14.5), α -glucosidase (EC 3.2.1.20), α -amylase (EC 3.2.1.1), etc., as well as antioxidative, immunomodulating, and antithrombotic functions, etc. The above-mentioned inhibitory functions of peptides are related to the regulation of blood pressure level (ACE inhibitors) and blood glucose concentration (DPP IV, α -glucosidase, α -amylase inhibitors). Thus, bioactive peptides are considered as food components that play an important role in the prevention of, e.g., hypertension, type 2 diabetes, and/or metabolic syndrome. Progress in the development of computer technologies has contributed to the elaboration of tools that are useful in the theoretical prediction of the properties of food components. Such methodologies are called *in silico* analyses and have become one of the three approaches applied in the study of proteins and peptides. *In silico* analyses are less costly and time-consuming when compared to classical approaches relying on the involvement of laboratory procedures to produce peptides from food. Thus, the aim of this study is to present the options available in the BIOPEPUWM[®] database of proteins and bioactive peptide sequences that can be useful in the evaluation of proteins as sources of bioactive peptides. Such options can be exemplified on any protein sequence available in the BIOPEP-UWM database. They include the elaboration of the profile of the potential biological activity of a protein, the frequency of the occurrence of peptides with a given activity within a protein, and the prediction of the enzymatic release of biopeptides from a protein using qualitative and quantitative criteria. Moreover, the search options of this database, as well as new updates, will be presented.

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Keywords: bioactive peptides; proteins; BIOPEP-UWM database

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Abstract: Peptides derived from food proteins exhibit a variety of bioactivities, such as the inhibition of angiotensin converting enzyme (ACE; EC

Author Contributions: Conceptualization, A.I.; methodology, A.I.; software, A.I., M.D. and P.M.; validation, A.I., M.D. and P.M.; formal analysis, A.I., M.D. and P.M.; investigation, A.I., M.D. and P.M.; resources, A.I., M.D. and P.M.; data curation, A.I., M.D. and P.M.; writing—original draft preparation, A.I.; writing—review and editing, A.I.; visualization, A.I.; supervision, A.I.; project administration, A.I., M.D. and P.M.; funding acquisition, M.D. All authors have read and agreed to the published version of the manuscript.

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Potencies of Green Extraction Techniques in the Production of High-Yield Inulin Powder from Jerusalem Artichoke [†]

Kardelen Demirci * , Ahmet Görgüç , Beyzanur Bayraktar and Fatih Mehmet Yılmaz



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Abstract: Inulin is a polysaccharide rich in dietary fiber and is widely used in

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functional foods due to its health-promoting properties. It has an important place in the current market, with the increasing demand for innovative formulations in the food and pharmaceutical industries. Jerusalem artichoke (*Helianthus tuberosus*) tubers are an important source of inulin, and this polysaccharide can be extracted for industrial use. Green solvent extraction systems have been used in recent years due to advantages such as non-toxic and environmentally friendly properties, as well as reducing solvent usage compared to traditional methods. In this study, inulin powder production from Jerusalem artichoke was carried out by conventional (C), hydro-tropic solvent (HS) and deep eutectic solvent (DES) extraction methods, according to the experimental plans created by the response surface methodology (RSM). The effects of independent parameters such as temperature, time and solvent ratio on inulin yield were investigated. Also, the combined effects of extraction parameters were examined using three-dimensional response surface plots. The optimum process conditions were determined as 79 °C process temperature, 36 min process time, 78 mL/g solvent ratio for C; 68 °C, 53 min, 59 mL/g for HS; and 79 °C, 51 min, 61 mL/g for DES. Among the extraction methods, HS provided the highest inulin yield (88.9%), followed by C (81.9%) and DES (81.5%). Inulin extracts produced under optimum conditions were purified by an ultrafiltration system and freeze-dried with a lyophilization process to obtain inulin powder. Viscosity and solubility values were also determined for each inulin powder sample. The solubility of inulin powders prepared by C, HS and DES extraction techniques were 91.5, 82.6 and 84.1%, respectively. The viscosity values of inulin powders within aqueous solutions (5 g/100 mL) were found to be 28.2, 17.1 and 8.1 mPa·s for C, HS and DES, respectively. The results depict that the highest inulin yield could be obtained by the hydro-tropic solvent extraction system, but the solubility and viscosity values were found to be the highest using the conventional extraction technique.

Keywords: extraction; inulin powder; response surface methodology; hydro-tropic solvent; deep eutectic solvent

Author Contributions: K.D.: Methodology, Validation, Investigation, Writing—original draft. A.G.: Methodology, Validation, Investigation, Formal analysis, Writing—original draft. B.B.: Methodology, Validation, Investigation, Writing—original draft. F.M.Y.: Conceptualization, Methodology, Writing—original draft, Supervision, Project administration. All authors have read and agreed to the published version of the manuscript.

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Every Drop Counts—The Current Methods for Determining the Quality of Human Milk [†]

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Abstract: Background and objectives: Human milk is the golden standard in infant nutrition. A very important segment of nutritional support for premature children is milk banks. In milk banks, during the process of storage and pasteurization, the characteristics of milk change, and consequently, its quality changes as well. Current electrochemical techniques (green analytical chemistry) can be used to determine the quality of milk regarding its total antioxidant capacity (TAC). Methods: The application of various electrochemical methods, such as differential pulse voltammetry, cyclic voltammetry, polarography, or potentiometry, enables monitoring of the quality and redox capacity of human milk and infant food. Changes in the TAC of human milk were examined after thermal treatments, which are commonly used in milk banks, as well as after supplementation with a fortifier. Results: The results obtained using electrochemical methods were compared to the most commonly used spectrophotometric methods for monitoring total antioxidant capacity. The obtained results showed that electrochemical methods can overcome the limitations of spectrophotometric methods, such as lower sensitivity, slower reaction and insensitivity at higher antioxidant concentrations. Cyclic and differential pulse voltammetry methods can be successfully applied as fast methods for testing milk quality in milk banks and clinical studies. Conclusion: The tested electrochemical methods are fast, cheap, and reliable in determining TAC since they are based on direct measurement of electron-donating components of milk and enable the quantitative determination of TAC in human milk and infant food. They are very important for routine and daily determinations of TAC in infant food, as well as for the control of milk freshness, especially after using fortifiers in neonatal units.

Keywords: human milk; premature children; milk bank; total antioxidant capacity; electrochemical methods



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Gluten Content of Gluten Free Products Marketed in Serbia [†]

Gordana Miodragovic^{1,*}, Ljilja Torovic^{1,2}  and Sanja Bijelovic^{1,3}



Belgrade, Serbia, 14–17 November 2023.

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[†] Presented at the 14th European Nutrition Conference FENS 2023,

Abstract: Celiac disease is a systemic autoimmune disease that occurs in genetically predisposed individuals and means a lifelong intolerance to gluten, which is found in wheat, barley, rye and oats, and leads to inflammatory changes in the lining of the small intestine. This is not a rare disease; it occurs in about 1% of the population. Recently, there has been a noticeable increase in the number and assortment of gluten free foods, which is marked with a crossed grain symbol or “gluten free” wording. The labeling, presentation and content of gluten in food intended for people intolerant to gluten is prescribed by the EU Regulation 828/2014 which has been harmonized in Serbian regulation. Gluten content not exceeding 20 mg/kg or 100 mg/kg justifies “gluten free” and “very low gluten” claims, respectively. The aim of this study was to assess gluten content in grain-based “gluten free” foods. Sixty samples of various grain-based food products (flour, bread, pasta, breakfast cereals and snacks, mainly made from corn, rice, buckwheat and millet) were analyzed using a commercially available sandwich ELISA test RIDASCREEN[®] Gliadin (R-Biopharm AG, Darmstadt, Germany). Gluten was not detected (<5.0 mg/kg) in 75% of the samples, 10% had gluten content up to 20 mg/kg, while 8% slightly exceeded the limit for gluten free products (22.0–24.0 mg/kg), which could be tolerated taking into account measurement uncertainty. One flour (52.0 mg/kg), one snack (58.0 mg/kg) and one pasta sample (96.6 mg/kg) had gluten concentrations at the levels requiring “low gluten content” product labeling instead of “gluten free” displayed on their packages. Furthermore, one snack product reached 196 mg/kg of gluten. The labeled composition of this product did not indicate the presence of raw materials that are natural sources of gluten. If true, this implicates cross contamination. The presented results indicate that there is a need for continuous education and rise of awareness among producers of gluten free food as well as improved efficiency of market control. Although the restaurants that offer a gluten free menu are nowadays a rarity in Serbia, they too should be included in control programs.

Keywords: celiac disease; gluten free; ELISA

Author Contributions: Conceptualization, G.M.M. and L.T.; methodology, G.M.M.; formal analysis, G.M.M.; investigation, G.M.M.; data curation, S.B.; writing—original draft preparation, G.M.M. and L.T.; writing—review and editing, S.B. and L.T. All authors have read and agreed to the published version of the manuscript.

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Fatty Acid Profile of Vegan Omega-3 Food Supplements †

Gordana Milojević Miodragović^{1,*}, Jelena Banović Fuentes² and Ljilja Torović^{1,2} 



Citation: Miodragović, G.M.; Fuentes, J.B.; Torović, L. Fatty Acid Profile of Vegan Omega-3 Food Supplements.

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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Consumers' current interest in vegan products

strengthens the market growth for omega-3 fatty acid (FA) supplements from (micro)algae, offering all the benefits of a high dose of eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids, which are commonly considered to support normal vision, heart, and brain health and immunity, without the safety and sustainability concerns associated with fish oil. Of the three main omega-3 FA, terrestrial plants typically contain only alpha-linolenic (ALA). This study aimed to assess the FA profiles and quality indices of plant-based omega-3 supplements that are convenient for vegans and vegetarians. A total of 12 omega-3 supplements, 7 based on terrestrial plants and 5 based on algae, were subjected to GC-FID analysis of FA profiles, which were further used for the calculation of lipid quality indices. The findings confirmed the identity as well as the pivotal differences between the FA profiles of algae and terrestrial plants: EPA and DHA, which were abundantly present in algae supplements ((23.1 + 36.3)%; (3.3 + 72.2)%;

45.6; and 46.1% of DHA in *Scizochytrium* sp. microalgae), were absent from other plants. The opposite observation was recorded for ALA, which was present only in terrestrial plant supplements: maximum 45.8% in flaxseed, 38.5% in mixed flaxseed/primrose/olive/rice husk/sea buckthorn oil, 26.7% in the hemp/flaxseed/spirulina mixture, and 11.0% in black currant/soy oil, whereas evening primrose supplements contained 10% of γ -linolenic acid. The most beneficial polyunsaturated to saturated FA ratio was obtained for primrose oil (7.8), followed by black currant/soy (5.9), flaxseed (3.2), and hemp/flaxseed/spirulina (2.9), whereas in algae supplements, it ranged from 1.6 to 6.5. The hypocholesterolemic/hypercholesterolemic index varied from 7.2 in hemp to 12.2 in primrose and from 2.7 to 22.6 in the case of algae supplements. The atherogenicity (IA) and thrombogenicity (IT) indices of both terrestrial plant and algae supplements were favorably low (IA 0.1–0.2 and 0.4; IT 0.1–0.2 and 0.02–0.2), along with high unsaturation indices ranging from 170.9–188.6 to 304.3–469.8, respectively. Considering the limited ability of the human body to convert ALA to EPA and DHA, algae supplements seem to be a better choice for vegans and vegetarians.

Keywords: vegan; food supplement; fatty acid

Author Contributions: Conceptualization, L.T.; methodology, J.B.F. and L.T.; formal analysis, J.B.F. and L.T.; investigation, L.T.; data curation, G.M.M.; writing—original draft preparation, G.M.M. and L.T.; writing—review and editing, L.T.; project administration, L.T.; funding acquisition, L.T. All authors have read and agreed to the published version of the manuscript.

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Nutritional and Bioactive Properties of Plant-Based Sausages Containing Potato Protein, Ferritin, and a Blend of Cold-Pressed Oils †

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Nutritional and Bioactive Properties of Plant-Based Sausages Containing Potato Protein, Ferritin, and a Blend of Cold-Pressed Oils. *Proceedings* **2023**, *91*, 277. <https://doi.org/10.3390/proceedings2023091277>

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Abstract: Every year, there is an increase in the interest of plant-based foods as alternatives to meat products. In addition to meeting the needs for basic macronutrients, consumers also expect such products to provide bioactive compounds that help to protect their health. In this project, innovative plant-based sausages were developed using protein from potato juice, characterized by a high nutritional value. Moreover, the addition of ferritin, a plant-based well-absorbed source of iron, was used, as well as an appropriate composition of oils with a favorable ratio of $\omega 6$ to $\omega 3$ fatty acids of 5:1. Effects on the functioning of the gastrointestinal tract, in particular, cytotoxicity against gastrointestinal cancer cells, were also analyzed. It has been shown that the developed plant-based sausages are not only characterized by a high nutritional value corresponding to meat products, but also contain phytochemicals beneficial in alleviating inflammation and cancers of the digestive tract. The sensory analysis performed also confirmed the high attractiveness of the new products, which can be successfully implemented into the market.

Keywords: meat alternative; nutritional value; innovative vegan product

Author Contributions: Conceptualization, P.Ł.K.; methodology, K.S. and P.Ł.K.; formal analysis, K.S. and P.J.; investigation, K.S., W.C., H.M.B., A.O., P.J. and P.Ł.K.; resources, P.Ł.K.; data curation, P.J.; writing—original draft preparation, P.Ł.K.; writing—review and editing, P.Ł.K.; supervision, P.Ł.K.; project administration, P.Ł.K.; funding acquisition, P.Ł.K. All authors have read and agreed to the published version of the manuscript.

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Mycobiota and Mycotoxin Content of Cereal Flours from a Serbian Market [†]

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Abstract: Altogether, 39 cereal flour samples taken from a Serbian market were analyzed for mycobiota and mycotoxin content, among which were six *Triticum aestivum* specimens, five *Triticum dicoccum* specimens, four *Hordeum vulgare* specimens, five *Fagopyrum esculentum* specimens, three *Secale cereale* specimens, five *Triticum spelta* specimens, four *Avena sativa* specimens, two *Oryza sativa* specimens, two *Zea mays* specimens, and one specimen each of *Panicum miliaceum*, *Triticum monococcum*, and *Triticum turgidum* ssp. turanicum. To determine the mycobiota content using dilution techniques, the flour samples were transferred to a non-selective DG18 nutrient. The number of coloniforming units (CFU/g) varied from less than 100 (in the case of five samples, namely, two *O. sativa*, and one specimen each of *S. cereale*, *H. vulgare*, and *T. aestivum*) to as high as 5000 CFU/g (*S. cereale*), 6000 (*A. sativa*), 11,000 (*T. aestivum*), and 40,000 (*Z. mays*). The identification of fungal genera and species was performed on Czapek-Dox Agar and Potato dextrose Agar on the basis of the isolates' colony characteristics and the morphology of the examined reproductive organs. The isolated fungi belonged to the following genera: *Aspergillus*, *Penicillium*, *Alternaria*, and *Fusarium*. Species from these genera are well-known mycotoxin-producing fungi. Among the identified species were *A. candidus*,

A. flavus, *A. carbonarius*, *A. ochraceus*, *A. oryzae*, *P. solitum*, *P. citrinum*, *P. griseofulvum*, *P. brevicompactum*, *A. alternata*, *F. avenaceum*, and *F. graminearum*. The mycotoxin content was determined via the ELISA technique using Eurofins Technologies Hungary KFT kits for aflatoxin B1, deoxynivalenol, total aflatoxins, ochratoxin A, and zearalenone. In the case of eighteen samples, the total aflatoxin content was above the limit of detection, and seven of these samples were contaminated with aflatoxin B1, eight were contaminated with ochratoxin A, two were contaminated with deoxynivalenol, and one was contaminated with zearalenone. Two samples of *T. aestivum* were contaminated with one or more toxins (33%), and the number of samples contaminated three for *T. dicoccum* (60%), one for *H. vulgare* (25%), four for *F. esculentum* (80%), one for *S. cereale* (33%), two for *T. spelta* (40%), three for *A. sativa* (75%), two for *O. sativa* (100%), two for *Z. mays* (100%), one for *P. miliaceum* (100%), one for *T. monococcum* (100%), and one for *T. turgidum* ssp. turanicum (100%).

Keywords: cereal flour; mycobiota; mycotoxin



Citation: Bagi, F.; Todoric, O.; Belovic, M.; Radosavljevic, M.; Barac, G.; Ilicic, R.; Torbica, A. Mycobiota and Mycotoxin Content of Cereal Flours from a Serbian Market. *Proceedings*

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The Efficacy of Inulin as a Cryoprotectant Agent on the Nutritional and Quality Characteristics of Frozen Sour Cherry Subjected to Different Freezing Treatments [†]

Ahmet Görgüç * and Fatih Mehmet Yılmaz



Citation: Görgüç, A.; Yılmaz, F.M. The Efficacy of Inulin as a Cryoprotectant Agent on the Nutritional and Quality Characteristics of Frozen Sour Cherry Subjected to Different Freezing Treatments. *Proceedings* **2023**, *91*, 273. <https://doi.org/10.3390/proceedings2023091273>

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Abstract: The aim of this study was to investigate the effects of inulin incorporation and three different freezing treatments (static, air blast, and individual

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quick frozen; IQF) on some quality characteristics of sour cherry (*Prunus cerasus* L.). Frozen foodstuffs expose undesired changes during storage, such as enzyme activity, and after thawing, such as drip loss. To overcome such issues, inulin, which is known for its cryoprotectant attributes, was added to sour cherry samples by an ultrasound-assisted vacuum impregnation method prior to different freezing treatments. Inulin addition decreased the drip loss (13–18%) in all sample groups, while the pectin methylesterase activity was reduced in samples frozen by air blast and IQF methods. On the other hand, gradual reductions were observed in the total phenolic and monomeric anthocyanin contents, along with antioxidant capacities, by the DPPH and ABTS methods compared to the control groups, except for sour cherry samples subjected to air blast freezing. Among freezing techniques, IQF outshined others yielding conserved nutritional and quality characteristics. The results of this study indicate that inulin can be utilized to maintain or improve the quality characteristics of frozen foods. In conclusion, rapid freezing technologies such as IQF may enable the prevention of several problems widely encountered in frozen sour cherry fruits.

Keywords: cryoprotectant; inulin; freezing method; frozen food quality; sour cherry; vacuum impregnation

Author Contributions: Conceptualization, A.G. and F.M.Y.; methodology, A.G. and F.M.Y.; validation, A.G. and F.M.Y.; formal analysis, A.G. and F.M.Y.; investigation, A.G. and F.M.Y.; writing—original draft preparation, A.G. and F.M.Y.; writing—review and editing, A.G. and F.M.Y.; project administration, F.M.Y. All authors have read and agreed to the published version of the manuscript.

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Abstract

The Effect of Sodium Metabisulfite Dipping Pretreatment on the Selected Quality Parameters of Apple Snacks [†]

Fatih Mehmet Yılmaz * , Semra Bozkurt, Ahmet Görgüç , Özlem Erdoğan, Hülya Yaman and Simge Kurumaz

Citation: Yılmaz, F.M.; Bozkurt, S.; Görgüç, A.; Erdoğan, Ö.; Yaman, H.; Kurumaz, S. The Effect of Sodium Metabisulfite Dipping Pretreatment on the Selected Quality Parameters of Apple Snacks. *Proceedings* **2023**, *91*, 271. <https://doi.org/10.3390/proceedings2023091271>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Apple chips, which are in the snack product category, are the forefront of research due to their nutritional value and high fiber and low fat contents. Sodium metabisulfite (E223) is widely used in the food industry to prevent the browning reactions that occur during drying processes. Sodium metabisulfite ($\text{Na}_2\text{S}_2\text{O}_5$) is a powder that is easy and safe to use, is highly accessible and is also inexpensive in terms of cost. However, in recent years, industry and academia have focused on reducing the sulfur dioxide concentration in foods. The objective of this study was to investigate the effect of sodium metabisulfite as a pretreatment on the bioactive and technological properties of apple chips using an air-circulated tray dryer. In this context, apple discs were immersed in $\text{Na}_2\text{S}_2\text{O}_5$ solutions prepared at three different concentrations (0.02, 0.1 and 0.5%), and then drying was carried out at 55 °C and 1.5 m/s air flow rates. The apple chips were also produced out of unpretreated discs using both a tray dryer and freeze dryer. The differences among the sample groups were compared by performing browning index, water activity, rehydration rate, total phenolic content and antioxidant capacity analyses. The findings showed that water activity (aw) values of the apple chips (0.28–0.32) were within reliable limits in terms of storage stability and shelf life. There was no significant difference between the aw values of the apple chips produced using different $\text{Na}_2\text{S}_2\text{O}_5$ concentrations, but the apple chips produced through the freeze-drying had the lowest aw value. The increasing concentration of $\text{Na}_2\text{S}_2\text{O}_5$ gradually increased the rehydration ratio of the chips produced in the tray dryer. On the other hand, the chips produced with the freeze dryer had significantly higher rehydration ratio (4.3) due to the porous structure. The browning index values of the chips gradually decreased with the increase in $\text{Na}_2\text{S}_2\text{O}_5$ concentration. Freeze-drying resulted in a higher conserved total phenolic content and antioxidant capacity value. Still, the $\text{Na}_2\text{S}_2\text{O}_5$ pretreatment also protected the bioactive components of the products when compared with those of the untreated apple discs.

Keywords: apple chips; drying; fruit quality; dipping pretreatment; sodium metabisulfite

Author Contributions: Conceptualization, F.M.Y.; methodology, F.M.Y., S.B., A.G. and Ö.E.; formal analysis, S.B., A.G., Ö.E., H.Y. and S.K.; investigation, S.B., A.G., Ö.E., H.Y. and S.K.; resources, F.M.Y., S.B., A.G. and Ö.E.; data curation, F.M.Y., S.B., A.G. and Ö.E.; writing—original draft preparation, F.M.Y., S.B., A.G. and Ö.E.; writing—review and editing, F.M.Y., S.B., A.G. and Ö.E.; supervision, F.M.Y.; project administration, F.M.Y., S.B., A.G. and Ö.E.; funding acquisition, H.Y. All authors have read and agreed to the published version of the manuscript.

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Abstract

The Effect of Storage Temperature on Chocolate Texture [†]

Sanja Oruc'evic' Žuljevic' ^{1,*}, Lejla Muhovic' ² and Amila Oras ¹

Citation: Žuljevic', S.O.; Muhovic', L.; Oras, A. The Effect of Storage Temperature on Chocolate Texture.

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Abstract: The texture of a particular food product has

great significance for the sensory perception of its overall quality. When it comes to chocolate, texture as hardness plays an important role not only for visual evaluation (surface appearance), but also for the sensory perception of chocolate melting in the mouth. This feature is affected by many factors, whereas the composition of chocolate (particularly fat content), the size and distribution of solid particles, as well as the storage temperature are the prime ones. The aim of this experiment was to test the texture of chocolate, depending on its type (white, milk, and dark) stored at three different temperatures (16, 20, and 25 °C), which is the most typical consumption temperature range. The texture of the chocolate samples was examined instrumentally using a texture analyzer and through sensory analysis carried out by skilled panelists. The obtained results showed that the influence of the storage temperature and the type of chocolate has a statistically significant impact on chocolate's hardness when determined by instrument, while in sensory evaluation, the type of chocolate is a predominant influencing factor. The hardness of chocolate was the lowest in white chocolate samples, and it decreased at higher storage temperatures, as expected. The sensory perception of chocolate melting was notably affected by the chocolate hardness. The general outcomes of the study have shown that there is a positive correlation between instrumental and sensory analysis methods.

Keywords: texture; chocolate; temperature; storage

Author Contributions: Conceptualization, S.O.Ž., A.O. and L.M.; methodology, S.O.Ž. and A.O.; software, A.O.; validation, S.O.Ž.; formal analysis, L.M. and A.O.; investigation, A.O. and L.M.; resources, S.O.Ž. and L.M.; data curation, A.O. and L.M.; writing—original draft preparation, S.O.Ž., L.M. and A.O.; writing—review and editing, S.O.Ž. and A.O.; visualization, A.O. and S.O.Ž.; supervision, S.O.Ž. project administration, S.O.Ž.; funding acquisition, S.O.Ž. and L.M. All authors have read and agreed to the published version of the manuscript.

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Long-Chain Polyunsaturated Fatty Acids Intake through Fish Oil Food Supplements [†]

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Abstract: With the current consumer interest in health and wellbeing, the market growth potential for long-chain polyunsaturated fatty acid (PUFA) supplements is greater than ever before. Fish oil (anchovy, mackerel, herring, sardines, tuna, salmon, cod, krill, etc.) is a concentrated source of beneficial PUFA for dietary supplements, with eicosapentaenoic (EPA) and docosahexaenoic (DHA) acid attracting the most attention due to their capacity to boost human heart and brain health and strengthen the immune system. This study aimed to assess the profile and intake of PUFA from fish oil food supplements. The fatty acid profiles of 42 fish oil supplements collected from the markets of the Republic of Serbia and the Republic of Srpska were obtained using GC-FID analysis. The intake of PUFA in the adult population was assessed by taking into account labeled daily doses of supplements and recommendation for an EPA+DHA daily intake of 250 mg. The mean (range) percentage contributions of EPA and DHA in total fish oil fatty acids were $24.6 \pm 11.3\%$ (5.5–57.6%) and $21.4 \pm 14.9\%$ (3.3–72.3%), respectively. The maximum EPA concentration was determined in a supplement acquired in a sport supplements store, while in the case of DHA, a supplement with a “premium” label took the leading position. On the other hand, the lowest levels were recorded in fish pearls and a supplement containing a mixture of fish, flax, and borage oils, the only one containing alpha-linolenic acid (ALA). The means and ranges of EPA+DHA intake corresponding to the minimum and maximum labeled doses were $202.1 \pm 120.3\%$ (1.1–577.6%) and $263.2 \pm 147.3\%$ (1.1–749.7%) of the daily recommended amount, respectively. Such intakes do not raise safety concerns for the general population. While the health benefits associated with PUFA intake are potent, the concerns over sustainability and risk of oceanic pollution cannot be neglected, especially in relation to potential contamination with methylmercury, one of the main reasons why great care is recommended for pregnant and lactating women (recommended additional DHA intake 100–200 mg/day) regarding the consumption of fish and fish products.

Keywords: food supplements; fish oil; fatty acid intake

Author Contributions: Conceptualization, L.T.; methodology, J.B.F. and L.T.; formal analysis, J.B.F. and L.T.; investigation, L.T.; data curation, S.B.; writing—original draft preparation, L.T.; writing—review and editing, S.B. and L.T.; project administration, L.T.; funding acquisition, L.T. All authors have read and agreed to the published version of the manuscript.

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The Use of Unconventional Feedings from the Industrial Waste of Oilseeds in Dairy Goat Nutrition: Effects on the Nutritional Quality of Milk and Dairy Products and on Human Health [†]

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Abstract: Background and objectives: Industrial oilseed by-products (*Cynara cardunculus* and *Camelina sativa*) (CACD) are rich in bioactive compounds. In recent years, the use of these byproducts as unconventional feed for dairy goat nutrition has been hypothesized. However, data on the effects of these by-products on the nutritional quality of milk and on human health are limited. Our aim was to evaluate the potential effect of consuming yogurt made from goat milk from goats fed with unconventional ingredients derived from the industrial residues of CACD on adult human health. Methods: In this randomized, crossover clinical trial, 20 clinically healthy adults (14F; mean age 37.7 ± 14.2 years) were randomly assigned into two groups to take one yogurt made from goat milk from goats fed with CACD or regular goat yogurt (C) daily for 1 month in each phase. Anthropometric, body composition and blood samples were collected from each subject at the beginning and end of the intervention phase. Results: After consumption of CACD yogurt, a reduction in the percentage and kg of fat mass (−1.5%, $p = 0.035$; −0.9 kg, $p = 0.042$, respectively) and an increase in the percentage and kg of fat-free mass (+1.5%, $p = 0.035$; +0.9 kg, $p = 0.023$, respectively) were evident. As for the blood parameters, a decrease in calcium (−0.3 mg/dL; $p = 0.028$) and sodium levels (−1.6 mEq/L; $p = 0.001$) after taking CACD yogurt, with significant differences between the two groups in sodium levels ($p = 0.045$), was reported. Analyzing the differences in terms of sex, HDL showed an opposite trend in terms of the variation ($p = 0.043$) between men (−7.7 mg/dL) and women (+0.7 mg/dL) after taking CACD yogurt. Regarding inflammatory parameters, after CACD yogurt consumption, subjects showed an increased but not significant trend concerning the levels of IL-1ra (+38.5 pg/mL), especially in women (+60.4 pg/mL) compared to men. In addition, a similar non-significant trend of reduced IL-2 levels (−0.3 pg/mL) was also observed, especially in men (−0.6 pg/mL). Discussion: The use of unconventional feed obtained from the by-products of industrial oilseed waste for dairy goat nutrition reported possible beneficial effects on human health, suggesting an amelioration in body composition and an improved trend in terms of inflammatory profile.

Keywords: yogurt; clinical trial

Author Contributions: Conceptualization, G.I., A.B. and F.S.; methodology, G.I., A.B. and F.S.; formal analysis, M.T.A.; investigation, M.T.A., G.P., M.D. and A.N.; writing—original draft preparation, M.T.A.; writing—review and editing, G.I., A.B. and F.S.; supervision, F.S. All authors have read and agreed to the published version of the manuscript.

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Selecting the Type of Grain and Fermentation Conditions to Improve the Nutritional Quality of Grains [†]

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Abstract: Context and Objectives: There is an urgent need for a dietary shift towards an increased consumption of plant protein foods. However, some nutritional and sensory challenges are associated with whole-meal grains and pulses. Fermentation is a promising technology for reducing antinutrients, increasing protein digestibility, and reducing starch digestibility in plant-based matrices. This study aimed to evaluate the impact of different fermentation conditions using different bacteria on the nutritional composition of grains and pulses. Methods: Milled wheat, buckwheat, and chickpeas were fermented using different bacteria or combinations of bacteria, i.e., *Lactobacillus delbrueckii* + *Streptococcus thermophilus* (Vega), *Lacticaseibacillus rhamnosus* (Lrham), *Leuconostoc pseudomesenteroides* (Lpseu), *Weissella confusa* alone (Wcon) or combined with *Lactococcus lactis* (Wcon + Lac), or *Pediococcus pentosaceus* (Wcon + Pen), for 24 or 48 h. Protein hydrolysis and protein and starch digestibility were measured using the O-phtaldialdehyde and Infogest methods, respectively. Starch digestibility was evaluated using the Englyst method. Dietary fibers (DF) were quantified. Results: In buckwheat, all fermentation conditions increased protein hydrolysis, especially Vega. In chickpeas, Lrham and Wcon, alone and in combination, increased protein hydrolysis. In wheat, fermentation did not increase protein hydrolysis. Protein digestibility increased only with Wcon + Pen in buckwheat. For chickpeas and wheat, fermentation did not increase protein hydrolysis, and it was lowest with Lpseu in both cases. Lpseu, Wcon + Lac, and Wcon + Pen led to increased DF in buckwheat, especially soluble high-molecular-weight (HMW) buckwheat (dextran formation). In chickpeas, no increase in DF content was observed due to the hydrolysis of oligosaccharides, but soluble HMW DF increased with Lpseu, Wcon + Lac, and Wcon + Pen (dextran formation). No significant change was observed for wheat DF. The starch hydrolysis index (HI) increased with Lrham over 48 h and Lpseu over 24 h but decreased with Wcon + Lac over 24 h in buckwheat. In chickpeas, HI was reduced in all conditions, the lowest values being with Wcon + Pen and Wcon + Lac. In wheat, HI increased with Lrham over 48 h and decreased with Wcon + Pen. Conclusions: The impact of the fermentation conditions tested differed depending on the grains. Some conditions improved the nutritional characteristics of these grains. These results show promising effects concerning the nutritional quality of grains, which need to be confirmed in finished products.

Keywords: grains; fermentation; protein digestibility; starch digestibility



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Potential of Lignocellulosic Agro-Waste to Produce Value-Added Products [†]

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Abstract: This work focused on the effect of combustion on the yield, composition, and strength of food-grade bio-alkali from lignocellulosic agro-waste. Seven lignocellulosic types of agro-waste, including plantain stalk, plantain peel (green and ripe), empty palm bunch, palm fiber, coconut fiber, and cocoa pod were sun-dried and combusted using two methods: open-air combustion (OAC) and muffle furnace combustion (MFC). Ash and potash yield from the two methods of combustion were determined using simple proportion calculations. A two-stage hydrothermal extraction process was carried out on the ash using a deionized water ratio of 1:10 for food-grade bio-alkali, and the leachates were evaluated for pH, alkalinity, and metallic ion contents using standard analytical methods. The data obtained were statistically analyzed via a two-way ANOVA. The OAC samples had a higher ash content range (8.24–18.6%) compared to MFC samples (7.37–9.89%). Potash yield (%) is both biomass and combustion-method dependent, with MFC having a higher average yield (3.05%) than OAC (2.35%). The pH of the leachates for all samples ranged from 10.3 to 12.0. All the agro-waste exhibited a similar pattern in the order of magnitude of the metals of which they were composed (K > Mg > Ca > Zn > Na). For the minerals, PO₄ was highest (193.1 g/L) in plantain stalk, and KOH and K₂CO₃ were least (10.0 g/L) in coconut fiber, while the highest alkalinity was obtained in ripe plantain peel (62.1 mg/L). The yield and quality of bio-alkali produced were influenced by the combustion method and source of biomass. The bio-alkali from the different biomass types tested can be used as sources of food-grade emulsifiers due to their high nature of alkalinity. This signifies zero waste and is also a boost to the circular economy. The average alkalinity studied under MFC was 33.6 mg/L and for OAC was 27.3 mg/L, suggesting that MFC is a more promising approach. Worthy of exploration is the significant high content (19.3 mg/L) of chlorine in plantain stalk.

Keywords: bio-alkali; biomass; combustion; food additives; zero-waste

Author Contributions: Conceptualization, U.O., D.O. and E.K.; methodology, U.O.; software, U.O. and D.O.; validation, U.O. and E.K.; formal analysis, U.O.; investigation, U.O. and E.K.; resources, TETFund; data curation, D.O. and E.K.; writing—original draft preparation, U.O.; writing—review and editing, D.O. and E.K.; visualization, U.O. and D.O.; supervision, U.O.; project administration, U.O.; funding acquisition, TETFund. All authors have read and agreed to the published version of the manuscript.

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Exploring the Impact of Traditional Processing Techniques on Iron Content and Bio-Accessibility of Six Iron-Rich Ingredients [†]

Ashi Khare and Amit Arora *



Citation: Khare, A.; Arora, A. Exploring the Impact of Traditional Processing Techniques on Iron Content and Bio-Accessibility of Six Iron-Rich Ingredients. *Proceedings* **2023**, *91*, 89. <https://doi.org/10.3390/proceedings2023091089>

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Abstract: Iron (Fe) deficiency is a leading cause of anemia among Indian adolescent girls. Supplementation and fortification alone may not effectively reduce the risk of iron

deficiency anemia. Therefore, sustainable food-based synergies and processing techniques must be developed to enhance mineral bio-accessibility (BAC) and bio-availability from naturally iron-rich foods. Traditional processing techniques that reduce antinutrient content and enhance mineral BAC have the potential to further enhance mineral bioavailability. This study quantifies the impact of traditional processing on Fe content and BAC in Fe-rich foods. It also quantifies the BAC of contaminant Fe from cooking in iron utensils. Three seeds were roasted and boiled in iron and non-iron utensils, and germinated. Three green leafy vegetables (GLVs) were roasted and blanched. Iron content was assessed using ICP-AES and the BAC was determined using dialyzability assay. Statistical analysis was conducted using MINITAB software, and Tukey's test was used to determine the difference between the means. The Fe content in raw seeds ranged from 5.6 to 6.6 mg/100 g, and GLVs contained 36–77 mg Fe/100 g (d.b). Processing significantly increased Fe content in seeds ($p < 0.05$), with a maximum increase of 68–258% in samples boiled in an Fe pan. Among the GLVs, only blanching led to a significant reduction (~65%) in Fe content. The BAC of Fe from seeds increased after roasting (46.6–63.6%) and germination (7.9–68%). In GLVs, the maximum increase in Fe BAC was obtained in blanched samples (102–203%). No notable difference in Fe BAC was observed between the seed samples processed in utensils made of Fe and non-Fe materials. The Fe content and its BAC in food are significantly impacted by processing. Iron utensils may increase Fe content, but the contaminant-Fe BAC is limited. Roasting might release Fe from the protein–Fe–phytate complex due to thermal treatment, while germination mobilizes antinutrients, which may improve Fe bioavailability. Blanching works favorably in case of GLVs which may be due to alterations in the soluble and insoluble dietary fiber ratio. These findings suggest that incorporating such processing techniques can be beneficial while formulating products with high Fe bioavailability to combat anemia.

Keywords: iron; food processing; bioavailability

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Influence of Freezing Methods on the Quality Parameters of Frozen Globe Artichokes [†]

Beyzanur Bayraktar * , Ahmet Görgüç, Kardelen Demirci and Fatih Mehmet Yılmaz



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Abstract: The edible parts of artichokes (*Cynara scolymus* L.) are usually preserved in brine due to the short harvest season; however, this is less preferred by both retail sales and the catering sector since the high amount of salt is harmful to health. Freezing is an alternative method in terms of providing longer shelf life. The final quality of frozen foods can vary with the rate of freezing and the structure, size and distribution of ice crystals formed during the freezing process. The formed ice crystals directly affect the cellular structure and thus resilience of the overall tissue. The aim of this study was to compare the effects of three different freezing methods, i.e., static, air-blast and individual quick freezing (IQF), on the quality characteristics of globe artichokes. In this context, globe artichokes were frozen until reaching a center temperature of -20°C , then thawed at 4°C to analyze the amount of ascorbic acid, total phenolic content, antioxidant capacity (with DPPH and ABTS method), color difference value, texture and microstructure. The findings showed that a moderate quick-freezing method or air-blast resulted in the most-conserved DPPH antioxidant capacity result. While the total phenolic content and hardness values were the lowest in static frozen samples, the ascorbic acid was found to be highest in this method. No significant difference was evidenced in the color difference values of the samples ($\Delta E = 7.9\text{--}8.4$). When the microstructures were examined, larger ice crystals were formed in the static frozen artichoke samples, followed by the air-blast and IQF processes. It can be concluded that smaller and homogeneously dispersed ice crystals in the artichoke samples frozen by IQF could better preserve the cellular structure.

Keywords: freezing methods; ice crystal formation; microstructure; bioactive compounds

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Is There an Association between Sodium-Based Additives and Total Sodium Content of Foods? [†]

Carla Almeida ^{1,2,3,*}, Eduarda Lopes ¹ and Patrícia Padrão ^{1,2,3} 

Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Excessive sodium intake is a major public health issue. Despite the large use of sodium-based additives, their contribution to sodium content is unknown. This work aims to study the association between the use of sodium-based additives and the sodium content of foods sold by a market-leading Portuguese food retail company. Methods: White-label pre-packaged foods and fresh products were included in this study. The salt content of pre-packaged foods was supplied by the company and converted to sodium. The sodium content of non-industrially packaged foods was estimated through food composition tables. Foods were categorized based on the World Health Organization sodium benchmarks. The sodium-based additives on the label's ingredient list were identified according to Regulation (EU) No. 1129/2011 and counted. Non-parametric tests ($n > 5$) were used to test the median sodium content (mg/100 g) (minimum, maximum) according to the use of sodium-based additives. Results: A rising sodium content was observed from 0 [56.7 mg (0, 39880)] to ≥ 3 additives [520 mg (60, 2080)] ($n = 2451$, $p < 0.001$). A total of 12 categories and 13 subcategories were analyzed. The use of sodium-based additives was associated with higher sodium content for the following categories (a) and subcategories (b): Confectionary (a) ($p < 0.001$), Chocolates/candies (b) ($p < 0.001$), Savory snacks (a) ($p < 0.001$), Salted biscuits (b) ($p = 0.027$), Fresh (a) and Processed meat/fish (a) ($p < 0.001$), Processed fruit/vegetables/legumes (a) ($p < 0.001$), Canned vegetables/legumes (b) ($p < 0.001$), Ices (a) ($p = 0.006$), Ready meals (a) ($p = 0.030$), Composite ready meals (b) ($p = 0.001$), Cookies (b) ($p = 0.007$), Cakes (b) ($p = 0.022$). The use of sodium-based additives was associated with lower sodium content for Beverages (a) ($p = 0.002$), Fish (heat treated) (b) ($p = 0.020$), and Pastries (b) ($p = 0.045$). Non-significant differences were observed for 4 categories and 5 subcategories. Discussion: A positive association between the use of sodium-based additives and the sodium content was observed. Inconsistent results were found across categories, suggesting the need for a deeper analysis of the foods included in each category or subcategory.

Keywords: sodium; additives; food categories

Author Contributions: Conceptualization and methodology: C.A.; investigation and data collection: C.A. and E.L.; Writing – original draft: C.A. and E.L.; Supervision: P.P.; Writing – review & editing: P.P. All authors have read and agreed to the published version of the manuscript.

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Difference between the Theoretical and Analytical Content of Selected Elements in Meals Prepared for Hospital Tube Feeding [†]

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Abstract: Background and objectives: Blenderized tube meals, with the proper preparation and application, can increase the nutritional variety of hospital nutrition, decrease the financial burden on the hospital system, and complement commercial enteral nutrition administration. As this type of diet is used mainly in fragile populations of patients, whose recovery depends largely on adequate nutritional intake, this study aimed to determine levels of certain elements in blenderized tube hospital meals and to compare the theoretical and obtained analytical values of those meals. Methods: Samples of 29 various freshly prepared meals based on meat ($n = 13$), dairy ($n = 9$), fruit ($n = 3$), and soups ($n = 4$) were collected in the Clinical Hospital Center Rijeka, Croatia. Those meals in different combinations make 14 daily menus consisting of three meals per day. Meals were prepared according to standard methods of thermal food processing and were blended with a mixer. Water remained after cooking was added to each meal until the proper consistency for tube feeding was achieved. The theoretical composition for each meal was calculated using the National Food Composition Database. Levels of macro-elements (Na, Mg, K, Ca) and trace (Fe) elements were determined with inductively coupled plasma mass spectrometry (ICP-MS) using Agilent 7500cx. Results: With the exception of Fe, theoretical values for all elements were from 1.3 to 2.4-fold lower in comparison to levels obtained by ICP-MS analysis. Benefits of meal consumption in term of essential elements were evaluated using the EFSA nutrient reference values. It was found that irrespective of the approach used, each of the 14 daily menus met the dietary reference values (DRV) for all elements except for Fe. Discussion: Due to the potentially insufficient intake of some microelements, one of which is Fe, dietitians and healthcare professionals should pay attention to meal composition when planning daily menus for tube-fed patients. For Na, intake should be reduced to prevent the development of chronic non-communicable diseases. Further studies should be conducted to determine if the national food composition database needs to be revised for micronutrient content.

Keywords: hospital diet; elements; enteral nutrition; ICP-MS; tube feeding

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The EU Food and Beverages Labels Explorer (FABLE)—A New Open-Access Web-Based Tool to Monitor Branded Food Products across Europe [†]

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Citation: Dias, J.; Grammatikaki, E.; Wollgast, J. The EU Food and Beverages Labels Explorer (FABLE)—A New Open-Access Web-Based Tool to Monitor Branded Food Products across Europe.

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Abstract: Background and objectives: Nutrients of concern (i.e., salt, sugars, and total fat/saturated fat) are associated with noncommunicable diseases (NCD); their intakes in adults across the EU are, on average, above the recommended intake. Reformulation policies for healthier food and beverage products are an NCD Best Buy to tackle unhealthy diets and could lead to lower intakes of these nutrients. However, regular monitoring of such policies and of food environments is lacking; good quality and representative data about the food offer in supermarkets are difficult or expensive to obtain. Aiming to support public monitoring of the nutritional quality of the food offer, the JRC developed a web-based tool to host data on branded food products across Europe. Methods: FABLE hosts data on branded food and beverage products across Europe collected within three public-funded projects, EUREMO, JANPA and Best-ReMaP. The aligned food product nomenclature makes for more effective data analysis. The FABLE design will allow for the addition of future data collection efforts. Results: FABLE's dynamic dashboard will enable users to explore, interact with and visualize data on the nutritional content of branded food and beverage products across Europe. Several food categories are covered, such as bread and bread products, breakfast cereals, soft drinks, and dairy products. FABLE allows for (1) country comparisons for specific nutrients and food groups, (2) deep dives into each country/food category-specific nutrient of concern, and (3) the possibility of making time comparisons on the progress of the nutritional quality of the food offer. Discussion: Currently, there is no publicly available systematic approach to collecting and accessing data to continuously monitor food offer across Europe. FABLE aims to close this gap by making data collected on branded food and beverages through EU-funded projects publicly available for researchers, policymakers and the public. Users will be able to interact with, explore and easily visualize data. This will allow for the public monitoring of the food supply across the EU, which can incentivize reformulation efforts and lead to an improved food offer, making healthier choices more available to consumers.

Keywords: monitoring; food supply; reformulation; web-based application

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Lactic Fermentation Increases Antioxidant Capacity and Phenolic Compounds in White and Red Varieties of Quinoa [†]

Rui Chu, Eulalia Uaila and Claudia E. Lazarte *



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properties, as well as its tolerance to harsh environments, quinoa has garnered increased attention in recent decades, with its production expanding to Europe and Asia. Polyphenols are secondary by-products of plants, exhibit positive impacts on health, including anti-mutagenic and antioxidant activities, which protect against oxidative-induced stress. This study focused on investigating changes in antioxidant capacity and phenolic compounds in white and red quinoa varieties during lactic acid fermentation with *Lactobacillus plantarum* 299v[®]. Throughout fermentation, pH and lactic acid formation were monitored every two hours until the pH dropped below 4.6. Samples before and after fermentation were analyzed for antioxidant capacities using 2,2-diphenyl-1-pic-ylhydrazyl (DPPH) and ferric ion-reducing antioxidant power assay (FRAP). The total polyphenol content (TPC) was measured using the Folin–Ciocalteu method, and the polyphenol profile was identified and quantified by UPLC-MS-UV. The findings revealed that fermentation led to a significant increase ($p < 0.001$) in TPC from 4.03 to 7.68 mgGAE/100 g and from 4.35 to 7.96 mgGAE/100 g for the white and red quinoa varieties respectively. Fermentation showed a significantly positive impact on the iron-reducing antioxidant capacity of quinoa ($p < 0.05$). Red quinoa had higher antioxidant levels than the white variety, with a similar trend observed in the DPPH assay. After fermentation, the antioxidant capacity in white and red quinoa increased from 7.90 ± 0.03 to 10.48 ± 0.11 (mgTE/100 g) and from 8.78 ± 0.06 to 11.75 ± 0.10 (mgTE/100 g), respectively. Furthermore, fermentation significantly ($p < 0.001$) increased the content of polyphenols with high antioxidant power such as epi-catechin, catechin, 4-Hydroxybenzoic acid, vanillic acid, chlorogenic acid, rutin and quercetin in both red and white varieties. In conclusion, lactic fermentation proved to be effective for increasing the phenolic content and antioxidant capacities of both quinoa varieties.

Keywords: fermentation; polyphenols; quinoa; antioxidant capacity

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Abstract: Quinoa (*Chenopodium quinoa Willd.*) is a pseudocereal originally grown in the Andean region of South America. Due to its nutritional and functional

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Fatty Acid Nutritional Indices of Hemp Seed Oil [†]

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Abstract: Hemp seed oil, obtained via the cold pressing of hemp seeds, is widely represented on the market. The objective of this study was to evaluate the fatty acid (FA) composition of hemp seed oil by means of nutritional quality indices. The FA profiles (37 FA) of 20 hemp seed oils marketed in several European countries were obtained using GC-FID and used for the calculation of lipid quality indices. As expected, considering the same plant source, FA profiles and the corresponding quality indices showed great similarity. Polyunsaturated to saturated FA ratio (PUFA/SFA) (6.8 ± 0.5) is used to assess the impact of diet on cardiovascular health (CVH) as PUFA can depress low-density lipoprotein cholesterol (LDL-C) and lower serum cholesterol levels, as opposed to SFA. Therefore, the higher PUFA/SFA ratio, the more positive the effect. Compared with this ratio, the hypocholesterolemic/hypercholesterolemic index (HH) (12.7 ± 0.8) may more accurately reflect the effect of FA composition on CVH. The index of atherogenicity (IA) (0.08 ± 0.005) is characterized by the main classes of SFA (which are pro-atherogenic, with the exception of C18:0) and unsaturated FA (which are anti-atherogenic). Therefore, foods with a lower IA can reduce the levels of total cholesterol and LDL-C in blood plasma. The index of thrombogenicity (IT) (0.11 ± 0.01) indicates the tendency of FA to form clots in blood vessels and provides the relationship between the pro-thrombogenic FA (C12:0, C14:0 and C16:0) and the antithrombogenic FA (MUFA, omega-3 and omega-6 FA). Thus, foods with a lower IT are beneficial for CVH. The unsaturation index (UI) (183.8 ± 5.1) represents the degree of unsaturation in lipids. Hemp oil showed advantages over sunflower and olive oils regarding PUFA/SFA (5.1 and 0.5, respectively) and IT (0.23 and 0.24), along with comparable IA (0.08 and 0.14), and substantially higher HH than olive oil (6.8). High UI indicates that unsaturated fatty acids abundantly present in hemp oil could easily undergo thermal degradation. Quality indices should be regarded as a valuable foundation for the valorization of hemp seed oil in nutritional recommendations.

Keywords: hemp oil; quality index; fatty acid



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Malting of Barley and Wheat Grains Impacts Their Metabolic Profiles in a Model of In Vitro Colonic Fermentation [†]

Oona Koivisto * , Kaisa Raninen , Otto Savolainen , Arto Koistinen , Marjukka Kolehmainen  and Carlos Gómez Gallego



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Abstract: Background and objectives: Malting is a

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germination process that alters the composition of cereal grains and can impact the digestion of various nutrients included in whole-grain cereals. This can have a further impact on the composition of dietary fiber fractions fermented by the gut microbiota. We investigated the impact of malting with barley (*Hordeum vulgare*) and wheat (*Triticum aestivum*) grains on gut microbial metabolites during in vitro colonic fermentation in a model of human gut. Methods: Raw and malted barley and wheat grains went through in vitro gastric and intestinal digestions and a 24 h in vitro colonic fermentation mimicking human intestinal activities. Metabolite analysis was performed using nontargeted gas chromatography-mass spectrometry (GC-MS) optimized for the analysis of in vitro gut fermentation samples. Results: Multiple metabolites, including amino acids and their derivatives (e.g., leucine and γ -aminobutyric acid), biogenic amines (e.g., tyramine, histamine, and putrescine), sugars and their derivatives (e.g., fructose and galactinol), fatty acids and associated metabolites (e.g., glycerol and 2-aminoethanol), and energy metabolism-associated compounds (e.g., lactic acid) from raw and malted cereals were identified. The metabolite profiles differed significantly between cereal species and between raw and malted grains. Furthermore, the metabolite profiles changed during the fermentation. At 0 h, there was less variation between the metabolite profiles of raw cereals than malted cereals. At 24 h, the difference between malted barley and wheat was even more pronounced, but raw barley and wheat differed more from each other than at 0 h. Malting increased the initial sugar and sugar derivative levels in the cereals, as expected. However, levels of most amino acids and their derivatives were significantly increased after the 24 h in vitro colonic fermentation. Discussion: The malting of cereal grains seems to influence the metabolites produced by the gut microbiota during colonic fermentation. Understanding how cereals and different processing methods affect gut microbial metabolism can help shed light on their microbial fermentation-mediated health impacts. The optimized GC-MS method used in this study was able to differentiate the different sample types and is thus an excellent tool for monitoring gut microbial metabolite profiles.

Keywords: metabolomics; microbiota; cereals

Author Contributions: Designing the study: O.K., C.G.G., O.S., M.K. and K.R., conducting the study: O.K., K.R., C.G.G. and O.S., analyzing and interpreting the results: O.K., K.R., C.G.G., O.S., A.K. and M.K., writing the abstract: O.K., C.G.G., commenting the abstract: K.R., O.S., A.K. and M.K. All authors have read and agreed to the published version of the manuscript.

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The Combined Effect of Gluten Addition, Cell Wall Integrity, and Low Hydration Level in Durum Wheat Bread on Textural Quality and Starch Digestibility [†]

Marianna Tagliasco ^{1,*}, Anna Baggio ¹, Donatella Peressini ¹ and Nicoletta Pellegrini ^{1,2} 



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Abstract: Several studies have focused on reducing the glycemc and insulinemic responses of starchy foods to lower the risks for major non-communicable diseases. A promising approach to limit the starch accessibility to alpha-amylase in cereals is by preserving the integrity of the cells where the starch is encapsulated. This protective effect is effective in flour, but it is lost when coarse semolina, rich in intact cells, is used to produce bread. It was hypothesized that long mixing times increased the cell wall porosity and, in turn, the digestive enzyme penetration. Moreover, food structure plays a key role in digestion and oral processing. The use of coarse semolina, however, reduced the cohesiveness of the breadcrumbs, increasing the disintegration and, in turn, the starch accessibility. Different bread structures can even be obtained by playing with water absorption in the dough. To investigate the effect of cell wall integrity, dough mixing times, and different bread textures on starch digestibility, six durum wheat bread samples were prepared using coarse semolina (CS, >1000 µm) or 20% gluten in substitution of CS, 70% water (optimum water absorption) or 55% water (low water absorption) and with different mixing times (5 or 45 min). The textural properties were evaluated by a texture profile analysis (TPA) and in vitro digestibility was assessed according to the Englyst's method. The bread sample produced with the addition of 20% gluten, low hydration (55%), and 5 min of dough mixing, was the least digestible at the end of intestinal digestion. This could be explained by the preservation of cell wall integrity, the effect of the gluten network being able to hamper the enzyme, and the presence of a cohesive crumb texture, due to the gluten addition and the low hydration. However, there is no information on the effect of such bread characteristics on oral processing and glucose and insulin release in humans. For this reason, we are now evaluating in healthy volunteers the oral processing and glycemc and insulinemic responses of the developed bread compared to a standard bread made with fine semolina to confirm the results found in vitro.

Keywords: semolina; intact cells; bread texture; starch digestibility

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Assessment of Protein Quality in Novel Foods by the European Food Safety Authority: Methodology and Challenges [†]

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Abstract: Background: An increasing number of novel protein sources have been developed in recent years, seeking approval to access the European Union (EU) food market. Consequently, the protein quality of these foods and food ingredients could become more relevant to the nutritional status and health of the EU population. Objectives: To provide an overview of the protein quality of novel foods assessed by EFSA and to identify the potential for further advancements of the methodological approach followed during the safety assessment. Methods: A search was carried out using the EFSA library portal to identify all the EFSA scientific opinions published under the EU regulatory frameworks for novel foods (NF) (Regulation (EC) 258/97; Regulation (EU) 2015/2283). Outputs addressing novel foods having 5 g of protein/100 g of NF for solids and 2.5 g/100 mL for liquids (FAO, 2013) or more were included in the study. Data extraction comprised information on the identity of the NF, protein content, digestibility, and anticipated protein intake. Results: Since 2004, 45 EFSA scientific opinions on the safety of novel proteins and their sources have been published [2004–2013: 9 and 2014–2023: 36]. The products comprised whole foods with substantial protein content, protein concentrates, and protein hydrolysates, with 45% being plant-derived, 29% animal-derived, and 11% of fungal origin. The intended uses were mainly as ingredients in foods (67%) and/or food supplements (56%). A high variability was noted regarding the approaches followed by applicants to assess protein quality. An increasing trend for the use of the Digestible Indispensable Amino Acid Score (DIAAS) was noted. The major challenges identified in the protein quality assessment of novel sources were related to the use of appropriate nitrogen-to-protein conversion factors for each NF, the robustness and validity of digestibility assessment methods, and its approach. Discussion: These findings indicate that there may be an opportunity to harmonize further the principles and methodologies used in NFs protein quality assessment within the EU food regulatory environment. This will allow accommodating recent trends in human protein nutrition whilst ensuring foods entering the EU market will not be nutritionally disadvantageous for consumers. **Keywords:** novel foods; alternative proteins; protein quality; protein digestibility

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Analysis of Innovative Processes within an Organic Apple Production System (CO-FRESH) [†]

Ewa Rembiałkowska ^{*}, Renata Kazimierczak, Hubert Dobrowolski  and Justyna Obidzin´ska



Citation: Rembiałkowska, E.; Kazimierczak, R.; Dobrowolski, H.; Obidzin´ska, J. Analysis of Innovative Processes within an Organic Apple Production System (CO-FRESH).

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Abstract: For the CO-FRESH (CO-creating sustainable and competitive FRuits and vEgetableS' value cHains in Europe) project, implemented under Horizon 2020, the main objective is to design and pilot innovative system approaches to agri-food value chains in order to scale up this innovation at the European level. The Association of Polish Organic Fruit Producers POLSKI EKOOWOC has been selected as a pilot unit of the CO-FRESH project. The association includes 20 certified organic fruit growers from central Poland. Their acreage comprises more than 600 ha of organic orchards and plantations, producing 30,000 tonnes of organic fruit annually. During the course of the CO-FRESH project, a uniform methodology was developed to analyse and redesign the selected pilot units. A definition and description of the EKOOWOC association as a value chain in fruit production was first made. Then, after appropriate project training, a SWOT analysis was carried out for EKOOWOC in a meeting of a Polish working group of 10 people representing the downstream links in the production chain of this pilot unit. At the same meeting, a selection of proposed innovations for EKOOWOC was carried out. Several innovations important for the development of the pilot unit were pre-selected. After a few days, through a DELPHI survey, the working group selected the most important innovations for the EKOOWOC pilot unit. The creation of an online shop for the sale of organic fruit was chosen; the commercial activity here is combined with an educational activity, as customers ordering fruit learn about the qualities of organic apples of different varieties. Another innovation is the composting of organic residues from the orchard, with the aim of minimising organic waste. Two experimental compost heaps were set up, made up of several layers of waste—straw, waste apples, soil from organic mushrooms, leaves from the orchard and cut branches. The compost used a preparation of microorganisms, fermented organic matter and a natural mineral containing 64 elements. The final innovation was the production of vinegar from organic apples that do not meet commercial requirements. These are healthy fruits with too-small a diameter or an unusual shape. This action also minimises producer losses and allows for the use of waste materials. Organic vinegar has great health-promoting qualities and can be used for both culinary and cosmetic–medicinal purposes. The innovations are currently in the implementation phase and will be implemented from October 2023.

Keywords: organic apple production; education; innovation; composting; apple vinegar

Author Contributions: Conceptualization, E.R., R.K., H.D. and J.O.; methodology, E.R. and R.K.; project administration, J.O.; writing original draft preparation, E.R.; writing—review and editing, H.D.; funding acquisition, E.R. All authors have read and agreed to the published version of the manuscript.

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Supporting the Development of Rural Areas with Experiential Learning about Embedded Food Systems—GOODFOOD Project [†]

Klaudia Kopczyn´ska ^{1,*} , Paola Migliorini ² , Alexander Wezel ³ , Carola Strassner ⁴ , Ivan Manolov ⁵, Adrian Timar ⁶  and Dominika Srednicka-Tober ¹ 



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Abstract: The GOODFOOD project, as an educational and research project supporting the sustainable development of food systems, is aimed at establishing cooperation between EU universities and rural territories and their communities related to food production through a number of educational activities. This work resulted in the development, exploration and implementation of experiential learning activities and outcomes enabling the academic community to develop and exchange knowledge about territorially embedded food systems (EFS) and gain insight into possible pathways of their implementation. Through these multidisciplinary activities, the academic community, with the involvement of the explored EFS actors, developed teaching materials to contribute to supporting the sustainable development of rural food systems and their communities, based on experience and peer-to-peer learning. Local knowledge, built on the traditions and experiences of the local territory, supported by the input of qualified university graduates, has the potential to contribute to building sustainable, territorially embedded food systems, addressing challenges related to, i.e., resource constraints, diverse food quality and safety aspects, the environmental impacts of food production, biodiversity, food sovereignty, adapting to climate change, etc. To achieve the project’s goals, educational content and activities tailored to students’ preferences and major educational gaps were created in the form of e-learning courses and intensive study programs (summer schools). Students from six countries (PL, IT, FR, DE, BG, and RO) participated in two experiential-learning-focused summer schools in the Münsterland and Piedmont regions (2022, 2023). The project research team analyzed the students’ understanding of the concept of EFS and identified their preferred methods of learning about EFS. Educational materials for students, descriptions of selected EFS case studies and a guide on innovative teaching about territorially embedded food systems addressed to academics working in this subject area were developed. The created, publicly available educational materials and approaches may be used in the future to support the restoration and development of socially, economically and environmentally sustainable EFS in the rural areas of Europe.

Keywords: Embedded food system; EFS; sustainability; innovative education; experiential learning; e-learning; intensive study programme; Europe; GOODFOOD

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The Partial Substitution of Processed Meat with Plant-Based Foods and the Risk of Cardiovascular Disease [†]

Meri Simojoki ^{1,*} , Niina E. Kaartinen ¹ , Mirkka Maukonen ¹, Kennet Harald ¹, Heli Tapanainen ¹, Anne-Maria Pajari ²  and Satu Männistö ¹



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Abstract: Background and objectives: Cardiovascular diseases (CVD) are the leading cause of death globally. A shift from animal-based diets to more plant-based diets is likely to reduce the risk of CVD. This modelling study aimed to assess the impacts of the partial substitution of processed meat with plant-based foods on CVD risk. Methods: We used pooled data from five Finnish cohorts ($n = 42868$, 78% men, aged ≥ 25 years at baseline, 7.9 years median follow-up time with 4421 incident CVD cases). Diet was assessed using a validated food frequency questionnaire at baseline and CVD cases were ascertained from national health registers. In the substitution models, 50 g/week of processed meat were substituted with similar amounts of plant-based foods (legumes, vegetables, fruits, cereals, or a combination of these). Cohort-specific hazard ratios (HRs) were calculated using a Cox proportional hazards multivariate model adjusted for relevant confounding factors. Pooled HRs were estimated from the cohort-specific HRs using a random-effects model. Results: There was a small yet statistically significant reduction in CVD risk when processed meat was partially substituted with legumes (men: HR 0.96, 95% CI 0.93–1.00, $p = 0.03$), vegetables (men: HR 0.99, 95% CI 0.99–1.00, $p < 0.001$, women: HR 0.98, 95% CI 0.96–0.99, $p < 0.01$), fruits (women: HR 0.98, 95% CI 0.96–0.99, $p < 0.01$), cereals (women: HR 0.96, 95% CI 0.94–0.98, $p < 0.01$), or a combination of plant-based foods (women: HR 0.98, 95% CI 0.96–0.99, $p < 0.01$). Discussion: The modelled partial substitution of processed meat with several plant-based foods was associated with lower CVD risk. Our findings suggest that even a small change towards a more plant-based diet may contribute to cardiovascular health at the population level and, moreover, environmental sustainability.

Keywords: cardiovascular disease; diet; sustainability

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Association between Fermented Milk Consumption and the Gut Microbiome in Finnish Adults [†]

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Abstract: Background and objectives: The consumption of fermented milk products has been considered beneficial for health. The moderate use of fermented milk products can also be part of environmentally sustainable diets. Findings on fermented milk and gut microbiome associations, however, have been inconsistent, and studies conducted on population-based samples are scarce. We examined whether the consumption of fermented milk (e.g., yoghurt, buttermilk, curdled milk) is related to individual gut microbiota diversity (alpha diversity), compositional differences in gut microbiota (beta diversity), or bacterial species abundances in Finnish adults. Methods: We used data from the National FINRISK/FINDIET 2002 study (final n = 1273, aged 25–65 years, 55% women). Diet was assessed with 48 h dietary recalls. Gut microbiota were analyzed using shallow shotgun sequencing. In our statistical analyses, multiple linear regression, permutational multivariate ANOVAs, and multivariate analysis using linear models (MaAsLin) were utilized. Our analyses were adjusted for sex, age, smoking, BMI, energy intake, and potentially gut microbiota-altering medicines (metformin and psycholeptics/analeptics). Furthermore, those treated with antibiotics within the past six months or who were pregnant were excluded from the final sample. Results: The mean consumption of fermented milk was 107 (SD 145) g/day. Fermented milk consumption was not associated with individual microbial diversity (alpha diversity, beta = 0.02, sd = 0.01, p = 0.18) or compositional variation between individuals' gut microbiota (beta diversity, R² = 0.001, p = 0.57). In species-level analysis, fermented milk consumption was associated with 15 bacterial species, of which 11 were positively associated, and 4 were negatively associated. The positive associations mainly included known lactic acid-producing/probiotic species such as *Bifidobacterium longum*, *Streptococcus thermophilus*, *Lactococcus lactis*, *Leuconostoc mesenteroides*, and *Lactobacillus delbrueckii*. The negative associations included species mainly from genus *Prevotella*, which has been associated with plant-rich diets. Discussion: No associations were found between fermented milk consumption and microbial diversity measures. In line with previous studies in the literature, however, our species-level findings indicated that fermented milk consumption was positively associated with the abundance of several beneficial genera, including *Lactobacillus* and *Bifidobacterium*, whereas findings regarding *Prevotella* species abundances have been inconsistent. Further studies are needed to explore the importance of these findings in relation to the role of fermented milk in healthy and sustainable diets.



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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data is available upon request through the Findata permit procedure. <https://www.findata.fi/en/>.

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A Qualitative Investigation into Perceived Barriers Experienced by European Female Agri-Food Entrepreneurs Situated in Rural Regions for Sustaining the Food Sector [†]

Maria McDonagh ^{*}, Tansy Ryan, Aisling Moran and Lisa Ryan 



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Abstract: Introduction: Agri-food systems in Europe are predominantly male-dominated. Female food entrepreneurs can play a key role in the development of novel, sustainable food products. The aim of the present study was to gain an increased understanding of the various barriers which female agri-food entrepreneurs situated in rural areas perceive as hindrances to their entrepreneurial growth and development. Methodology: A total of five separate focus groups ($n = 29$ participants; 18 females) were carried out with agri-food entrepreneurs throughout Europe (Ireland, Belgium, Poland, Italy). The discussions were semi-structured and revolved around individuals' perceptions of the support received from their surrounding infrastructure and their opinions on mentorship programmes. A reflective thematic analysis was conducted following verbatim transcription of the conversations from the focus groups. Findings: Three major themes were identified: 1. Business Initiation and Development, 2. Perceived Barriers, and 3. Mentorship Programmes. Of these central themes, each of these themes was further divided into accompanying sub-themes. The most often-cited theme was the lack of adequate financial support and experiencing frustration with the complexity of funding application administrative processes. Socio-cultural support was oftentimes lacking, with participants noting they often felt more senior, experienced entrepreneurs gatekept information to avoid their development and expansion. Females in particular experienced gender-discriminatory behaviour from peers and those more senior than themselves. Finally, the vast majority of participants were aware of the benefits of an online presence but lacked confidence in their digital abilities and were unsure where to source the relevant support. Conclusions: These findings highlight a range of issues that need to be addressed to improve the infrastructure surrounding agri-food entrepreneurs throughout Europe and sustain the food sector. This knowledge may be used to guide policymakers and those at decision-making levels.

Keywords: entrepreneurship; perceptions; barriers; mentorship; supports; female entrepreneurship

Author Contributions: M.M. developed the data concept, collection and funding application for the research reviewed, and refined the written manuscript; L.R. developed the data concept, collection and funding application for the research reviewed, and refined the written manuscript; T.R. analysed the interview transcripts, generated codes, and was major contributor in writing the manuscript; A.M. compiled the interview transcripts and was contributor in writing manuscript. All authors have read and agreed to the published version of the manuscript.

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The Representation of Non-Meat Proteins in Food-Based Dietary Guidelines: A Review of National Guidelines in Europe [†]

Hannah E. Theobald * and Veronica Moran



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: To reduce the risk of chronic disease and the environmental impact of the food system, the FAO/WHO

recommend a shift towards more plant-based diets, with reduced intakes of red and processed meat. Sustainable diet messaging, including messaging on non-meat proteins in national food-based dietary guidelines (FBDGs), is one tool for encouraging population dietary shift. Objectives: to understand how protein foods are represented in FBDGs in Europe, including non-meat protein sources, and the extent to which meat reduction messaging are incorporated. Methods: A review of national FBDGs in Europe, as listed in the FAO repository of global FBDGs, was undertaken between February and March 2023. The review identified which protein sources were displayed pictorially in food guides and mentioned in accompanying resources, plus any meat reduction messages. Where FBDGs were not available in English, Google Translate was used. Results: A total of 35 national FBDGs were published in FAO's European region between 2002 (Croatia) and

2022 (Spain, Turkey); 30 FBDGs incorporated pictorial food guides and 34 provided text guidance. In pictorial representations of the protein food groups, three had no food images, eight showed animal-based proteins only (including dairy products and eggs), and 19 showed both animal and non-meat proteins, of which one (Israel) separated meat and eggs from plant sources of proteins, grouping them with dairy products, in keeping with Kashrut law. 12 FBDGs provided information on non-animal protein sources in text guidance: all mentioned legumes, five mentioned alternative protein sources, specifically tofu (five), soy products and mycoprotein (three) and vegetarian foods/alternatives (four). In total, 23 FBDGs mentioned general meat reduction, 12 advised to eat less total meat or limit consumption, and 12 advised to 'limit red meat' and 18 to limit 'processed meat'. Discussion: This analysis shows that many European countries lack practical population-level recommendations on healthy, sustainable diets. Greater use of pictorial and textual references to non-meat protein sources in FBDGs would increase awareness of plant- and fungi-derived sources, as more sustainable protein sources. It would be prudent to incorporate more varied protein sources, including both plant- and fungi-derived protein sources, in updates to national FBDGs.

Keywords: mycoprotein; sustainable diet; food-based dietary guidelines

Author Contributions: Conceptualization, H.E.T.; methodology, V.M.; validation, H.E.T.; formal analysis, V.M.; investigation, V.M.; resources, V.M.; data curation, V.M.; writing—original draft preparation, V.M.; writing—review and editing, H.E.T.; supervision, H.E.T. All authors have read and agreed to the published version of the manuscript.

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Students and Healthy Eating: The Behavior–Intention Gap in an Unhealthy Food Environment †

Amely Verreijen * , Annick de Leeuw and Herman Peppelenbos



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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Our food environment has a large influence on what we eat.

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The food environment around five schools in ‘Education Boulevard’ in the city of ‘s-Hertogenbosch (The Netherlands) is not healthy. Approximately 30 food outlets are present, and over 90% of the food products these outlets offer fall outside of the Dutch nutritional guidelines for healthy products (wheel of five). The aim of this study was to investigate the eating behavior of students in this food environment and to study the potential difference between what students say they consume at or around school (survey) and their actual food buying behavior (observations). Methods: This study was conducted in two steps: 1. A total of 251 students of the ‘Education Boulevard’ (≥16 years) filled in a survey which asked the following: what do they eat at or around school and where do they buy/get these foods? 2. Based on the survey, the five most popular food outlets were identified. At these five food outlets, the buying behavior of 267 students were observed: what did they actually buy? Results: The top three products that the students said they buy in the survey were as follows: 1. breads/sandwiches (16% of all indicated products), 2. salads (14%), and 3. sandwich toppings

(14%). Our observations, however, show different results. The top three bought foods were as follows: 1. (fried) snacks (27% of total bought products), 2. breads/sandwiches (26%), and 3. sugar-sweetened beverages (12%). Salads, which were mentioned in the survey as the second most frequently bought food, were actually only bought by 3 out of the 267 observed students. Of the 448 products that the students actually bought (based on the observations), 94% did not fit within the Dutch wheel of five for healthy products. Discussion: This study demonstrates that students’ food buying behavior is in line with the food on offer (>90% outside the wheel five) and underlines the need for interventions in the food environment. This study also highlights the intention–behavior gap, showing that what students say they do and what they actually do is not in line. Therefore, a survey is not the best method to study food buying behavior.

Keywords: food environment; students; health; behaviour–intention gap

Author Contributions: Conceptualization, H.P. and A.V.; methodology, H.P. and A.V.; data analysis, A.V.; writing—original draft preparation, A.V.; writing—review and editing, A.d.L. All authors have read and agreed to the published version of the manuscript.

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Optimizing the Dutch Adult Diet for 2030 and 2050 for Health and Sustainability, Based on EAT-Lancet Environmental Planetary Boundaries [†]

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Abstract: The current Dutch diet fails to meet existing nutritional guidelines, and exceeds the environmental boundaries set for a sustainable food system. We demonstrated that, if there are no changes to the current diet, the Earth system's boundaries will be further exhausted. Therefore, it is of importance to decrease the environmental impact of the Dutch diet while meeting relevant nutritional recommendations. A future planet-based diet for the Netherlands was created using Optimeal[®], a diet optimization software, the most recent food consumption survey, and environmental impact data for the Netherlands (Agri-footprint 6 database) for males and females (18–50 years). The environmental data was adjusted to incorporate forecasted improvements in 2030 and 2050 and to align with the scope of the planetary boundaries defined by the EAT-Lancet commission. The planetary boundaries translated into optimization constraints with a system boundary from cradle-to-processing for five environmental indicators (GHG emissions, blue water use, cropland use, phosphorus application, and surplus nitrogen), and the nutritional constraints were based on the Dutch food-based dietary guidelines. Furthermore, acceptability constraints were placed on food group consumption: 33–150% of current intake. The results show the optimized diets that meet the environmental and nutritional constraints for Dutch males and females in 2030 and 2050. The required changes in intake point towards a reduction in meat, eggs, fats and oils, potatoes and tubers, and sugar and confectionery, and an increase in legumes, nuts and seeds, vegetables, fish, and meat replacers. In the optimized diets, the main source of protein is 64–74% derived from plant-based products, instead of animal-based products, which is the case for the current diet. The optimal diets reduce the impacts on biodiversity loss by 55–84%. Although it contains a substantial change in protein source, the diet remains acceptable for the majority of consumers in this study, and fits within the planetary boundaries. These results contribute to the development of future planet-based dietary guidelines for the Netherlands.

Keywords: healthy diet; planetary boundaries; optimization; food-based dietary guidelines; biodiversity



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Territorially Embedded Food Systems as a Response to the Challenges of Globalization—Students Understanding, Current Status, Needs, and Expectations of University Education in This Subject Area: A Case from Poland †

Klaudia Kopczyn´ska ^{1,*} , Rita Góralaska-Walczak ¹, Renata Kazimierczak ¹, Carola Strassner ², Alexander Wezel ³, Paola Migliorini ⁴ and Dominika Srednicka-Tober ¹



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Abstract: A concept of resilient, embedded food systems (EFS), environmentally, economically, culturally, socially, and historically linked to certain territories, has been recently gaining attention as a vital response to the globalization of food systems and all its associated challenges. Support for territories on their way to sustain or restore such community-centric, embedded food systems requires transdisciplinary knowledge and skills, and thus effective food system education, including higher education, has an important role to play. The GOODFOOD study looked into the students' interest in the topic of regional and territorial food systems and their opinion on the importance of certain elements of a food system that is embedded in a region or territory. Students were also asked about the presence of courses or topics related to territorially or regionally embedded food systems in their study programs, their opinion on the usefulness of such courses for their future employment, and the most demanded teaching methods that should be applied to study EFS topics. An online survey carried out among students of the Warsaw University of Life Sciences in Poland of selected study programs related to food science revealed that 70% of respondents are interested in the topic of regional food systems. At the same time, 50% of students have not had any courses related to territorial food systems in their study programs so far, even though over 70% think that such a course would be useful for their future employment. Interactive field trips and excursions, international courses (in a multicultural, international environment), interactive workshops, and cooperation with food system stakeholders (i.e., an internship in a food company) were among the most highly demanded teaching methods to study EFS.

Keywords: embedded food systems (EFS); GOODFOOD project; Erasmus+; regional and territorial food; teaching methods; education

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Nutritional Quality and Environmental Sustainability of Dietary Protein Patterns in Europe †

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Abstract: Background: A dietary shift from animal-based protein

foods towards plant and/or alternative protein foods (i.e., protein transition) has gained increasing interest in Europe as a solution to reduce environmental impacts and improve human health. However, to shape this protein transition, it is first needed to gain more insights into current protein-rich food consumption habits across European countries and related nutritional and environmental impacts. Objectives: This research aimed to (1) identify distinctive dietary protein patterns in Europe and (2) assess their associations with nutritional quality and environmental sustainability. Methods: Individual-level food consumption data collected from multiple 24 h dietary recalls or food records were obtained from nationally representative dietary surveys of 25 European countries (40,101 participants, 18–64 years), available from the European Food Safety Authority (EFSA) Comprehensive Food Consumption Database. We applied statistical clustering to classify individuals according to consumption of 24 protein-rich food groups. The obtained patterns were evaluated for nutritional adequacy, nutritional quality, and environmental impacts using the Dutch Food Composition (NEVO) and a European environmental sustainability indicator (SHARP-ID) databases. Results: Six dietary protein patterns were identified: “Common” (42%), “Junk” (20%), “Traditional” (15%), “Health-conscious” (12%), “Dairy-rich” (10%), and “Plant-forward” (2%). Protein intake ranged from 0.89 g/kg body weight in the “Common” pattern to 1.27 g/kg body weight in the “Traditional” pattern. The “Plant-forward” and “Healthconscious” patterns achieved the highest nutritional quality, whereas that of the “Common” pattern was lowest. Greenhouse gas emissions and land use were comparable between patterns, except for the “Plant-forward” and “Traditional” patterns where impacts were, respectively, lower and higher. Discussion: Dietary protein patterns are linked to unique nutritional profiles and vary to some extent in environmental impacts, indicating that distinct approaches are needed for closing nutritional gaps and overcoming environmental challenges. This also stresses the need for considering cultural differences in eating habits for successfully shifting towards plant- and/or alternative protein foods.

Keywords: protein transition; protein sources; dietary protein pattern; nutritional quality; environmental impact

Author Contributions: Conceptualization, M.C.D., P.v.t.V. and S.B.; Methodology, M.C.D., P.v.t.V., E.H.M.T., A.K., M.G. and S.B.; Formal analysis, M.C.D.; Investigation, M.C.D., P.v.t.V., E.H.M.T., A.K., M.G. and S.B.; Writing—original draft, M.C.D.; Writing—review and editing, M.C.D., P.v.t.V., E.H.M.T., A.K., M.G. and S.B.; Supervision, P.v.t.V. and S.B. All authors have read and agreed to the published version of the manuscript.

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Developing Ecologically Sustainable Recipes for Older Adults with Obesity during a Period of Weight Loss: The First Step in the 2EAT Project [†]

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Developing Ecologically Sustainable Recipes for Older Adults with Obesity during a Period of Weight Loss: The First Step in the 2EAT Project.

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Abstract: Background and objectives: Dietitians often advise older adults to eat animal-based proteins during a period of weight loss. Animal-based proteins in general have a higher protein quality and a higher potential to stimulate muscle protein synthesis and might therefore better preserve muscle mass during weight loss compared to plant-based proteins. However, animal-based proteins have a high environmental impact. The 2EAT project aims to study the effect of a 60% plant-based protein diet compared to a 60% animal-based protein diet on muscle health and general health during a period of weight loss. The first objective in this project is to develop recipes that dietitians can use to coach older adults with obesity on moving towards a more plant-based diet. The recipes need to be nutritionally adequate, with 1.2 g/kg protein/kg body weight and high protein quality per meal, need to fit into an energy-restricted diet and must be feasible for the target group. Methods: The development of the recipes consisted of several steps. 1. Develop recipes for meals that, on daily average, meet the nutritional criteria and are feasible for the target group. 2. Have focus groups with the target group to evaluate the feasibility of the recipes. 3. Interview dietitians on the nutritional adequacy and feasibility of the recipes. 4. Based on steps 3 and 4, adjust the recipes. The recipe book is then provided to the target group (n = 18) so they can prepare at least seven meals to rate and evaluate these meals. Based on their findings, adaptations are made. Results: The developed recipes meet the nutritional criteria. The average rating of the meals on a scale of 1–10 is a 7.5. In general, the target group is positive and mentions that the recipes are easy to prepare, taste good, and are not too expensive. Improvements need to be made to some recipes: the portion sizes were too large, they were not tasty enough, and/or the recipe description needs to be reformulated. Discussion: The next step is to pilot nutritional counselling with a dietitian with the use of these recipes for 8 weeks to see whether the target group reaches 60% plant-based protein and the other nutritional criteria.

Keywords: plant based protein; animal based protein; muscle mass; older adults; obesity; weight loss; recipe books

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Development and Testing of a Short Scale to Estimate the Importance of Economic, Social and Environmental Sustainability of Fermented Plant-Based Foods [†]

Jean-Paul C. Garin ^{1,*} , Federico J. A. Perez-Cueto ¹  and Inês Magalhães ²



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and Objectives: The social and economic attitudinal dimensions of sustainability are difficult to estimate and are often overlooked in consumer research. To date, few scales can be used to assess in a combined manner the importance given by consumers to social, economic and environmental sustainability. In the frame of the EU-funded HealthFerm Project, a scale to estimate the relative importance of three dimensions of sustainability was necessary. Therefore, the objective was to develop and test a short scale that would englobe all the keywords that are present in the definition of sustainable development and that would assess the importance of each dimension in the eyes of consumers. Methods: A test-retest reliability study with a sample of volunteers ($n = 15$) who agreed to fill out the questionnaires twice. Cronbach's alpha was used to evaluate internal consistency. A paired samples t -test was used to evaluate the repeatability of the scale. Results: Of the 15 respondents, seven were women (46.7%); the mean age was 23.5 years (s.d.: 2.4); 66.7% lived in an urban area and 33.3% in a suburban area; 53.3% had a higher education; 46.7% of the sample described their economic situation as neither easy nor difficult. Regarding their diet, 26.7% were flexitarian, 66.7% omnivore and 6.7% pescetarian. There was no difference (paired samples t -test; p -value > 0.05) between the two time points, indicating that the scale is reliable. Furthermore, the scale showed very good internal consistency (Cronbach's alpha of 0.98). Conclusion: The short scale can be used to evaluate how important the different dimensions of sustainability of fermented plant-based foods are to consumers.

Keywords: sustainability dimensions; scale development; consumer studies; fermented foods; plantbased diet

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A Workshop on Food Consciousness and Traditional Japanese Culinary Practice Increases Awareness of Sensory Food Properties, Mindful Eating, and Food Waste Reduction Actions [†]

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Abstract: Background and objectives: Food waste and unhealthy food choices contribute negatively to planetary health. Tackling this global concern and promoting sustainability require cross-disciplinary action. “Mottainai (‘What a Waste!’)”, a Japanese term rooted in ethical and religious principles, calls for more sustainable lifestyles and mindful food consumption. We developed a workshop applying the Mottainai concept to explore sensory food properties, food consciousness/mindful eating, and food waste. The objective was to evaluate the effect of the workshop in adults. Methods: Participants were recruited at Glasgow University and invited to attend a 2.5 h workshop consisting of Mottainai concepts, Japanese traditional culinary practice (i.e., food fermenting to optimise nutrient content whilst reducing food waste), and food tasting. Participants answered before (PRE) and after (POST) workshop questionnaires. Questions with five-point Likert scale answers (1 = never/2 = sometimes/3 = about half of the time/4 = most of the time/5 = always) measured awareness of food sensory properties (4 items), food consciousness/mindful eating actions (6 items), and food waste reduction actions (1 item). Nonparametric statistics evaluated changes between the scores obtained before and after the workshop. Results: The participants (n = 76) were students and staff members in the field of nutrition (n = 20) and other study/work fields (n = 43). The questionnaire response rate was 83% (n = 63). After the workshop, participants gave increased median scores (25th, 75th percentiles) for most food sensory awareness items: texture/flavours (PRE 4(4,5) vs. POST 5(4,5), $p = 0.007$), smells/aromas (PRE 4(4,5) vs. POST 5(4,5), $p = 0.002$), and sound of eating (PRE 3(2,4) vs. POST 4(3,5), $p < 0.001$). The scores for appearance remained unchanged. Food consciousness/mindful eating significantly increased for eating slowly (PRE 3(2,4) vs. POST 4(3,4), $p < 0.001$) and considering food value from other dimensions (e.g., agriculture) (PRE 4(2,4) vs. POST 5(4,5), $p < 0.001$), but the other items remained unchanged. After the stratification by study/work in Nutrition, the results remained similar, except for smells/aromas, and there was an additional significant increase in taking food waste reduction actions (PRE 4(3,4) vs. POST 5(4,5), $p = 0.011$). In other study fields, the scores for smells/aromas (PRE 4(4,5), POST 5(4,5), $p = 0.001$), sounds (PRE 3(2,4), POST 4(3,5), $p < 0.001$), and eating slowly (PRE 3(2,4), POST 4(3,4), $p < 0.001$) remained significantly higher. Discussion: The workshop had a small but positive effect on food sensory awareness, food consciousness/mindful eating, and food waste reduction actions, with potential to positively contribute to planetary health.

Keywords: planetary health; food sensory activities; cooking demonstrations; Mottainai; Japanese culture

Author Contributions: Conceptualization, A.L.G. and S.Y.; methodology, A.L.G. and S.Y.; formal analysis and data curation, M.B.; writing—original draft preparation, A.L.G.; writing—reviewing and editing, A.L.G. and S.Y.; funding acquisition, S.Y. All authors have read and agreed to the published version of the manuscript.

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Analysis of Pesticide Residues in Apples in the Institute of Public Health of Belgrade for 2022 [†]

Stefanija Nikolic^{1,*}, Vesna Pantic-Palibrk¹, Maja Ristic¹, Dunja Koprivica¹, Danica Stošić¹ and Vladimir Nikolic²



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Apples are an important part of a healthy diet and one of the most widely consumed fruits globally. The use of pesticides in apple production has also increased, which can lead to pesticide residues in fruit. Pesticide residues in food have been a significant public health concern due to their potential adverse effects on human health, including their carcinogenic, neurotoxic, and endocrine-disrupting properties. To ensure food safety, and reduce unnecessary consumer exposure, regulatory agencies worldwide have set maximum residue limits (MRLs) for pesticides in fruits and vegetables. This study aims to analyze the levels of pesticide residues in apples and evaluate their compliance with regulatory MRLs. Methods: The analysis of the data regarding pesticide presence and compliance with defined MRLs from the results of testing apple samples (by GC MS/MS and LC MS/MS techniques) at the Institute of Public Health of Belgrade, including pesticide residue monitoring apples on the Serbian market in 2022, was performed. Results: Out of 34 apple samples tested, 21 samples (61.8%) were found to have pesticide residue levels below the MRL, 8 samples (23.5%) had no pesticides detected, while 5 samples (14.7%) exceeded the MRL. The number of detected pesticide residues in the apple samples varied widely, ranging from 0 to 11, with an average of 3.38 residues per sample. The most frequently detected pesticides were acetamiprid, captan, cypermethrin, fludioxonil, carbendazim, and chlorantranilprole. The five samples that exceeded the MRLs were found to contain the following pesticides and levels: three samples contained chlorpyrifos at 0.07, 0.011, and 0.015 mg/kg, respectively, exceeding an MRL of 0.01 mg/kg; one sample contained imidacloprid at 0.015 mg/kg, which exceeded the MRL of 0.01 mg/kg; and one sample contained flormetanate at 0.058 mg/kg, exceeding the MRL of 0.01 mg/kg. Discussion: Overall, the study's findings suggest that most of the samples analyzed are within the MRLs for pesticide residues, indicating that the apples are safe for consumption. However, the detection of pesticide residues above the MRLs underscores the need for the continued monitoring and enforcement of pesticide regulations to ensure food safety and minimize the potential health risks associated with pesticide exposure.

Keywords: apples; pesticide residues; health risks

Author Contributions: Conceptualization, S.N. and V.P.-P.; methodology, S.N. and V.N.; formal analysis, V.N.; resources, S.N. and M.R.; data curation, S.N., D.S. and D.K.; writing—original draft preparation, S.N., M.R. and D.S.; writing—review and editing, V.P.-P., D.K. and V.N.; visualization, V.N.; supervision, V.P.-P. All authors have read and agreed to the published version of the manuscript.

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Which Messages about Healthy and Sustainable Eating Resonate Best with Consumers of Low Socio-Economic Status? [†]

Aikaterini Palascha ^{*}, Betty Chang and Nina McGrath



Citation: Palascha, A.; Chang, B.; McGrath, N. Which Messages about Healthy and Sustainable Eating Resonate Best with Consumers of Low Socio-Economic Status? *Proceedings* **2023**, *91*, 260. <https://doi.org/10.3390/proceedings2023091260>

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Abstract: Consumers of low socio-economic status (SES) face unique challenges in eating healthily and sustainably, and as

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a result, are disproportionately affected by the greater risks of chronic diseases and environmental degradation. This dietary inequity is further reinforced by inequalities in access to health information. In this research, we examine the missing perspectives of consumers of low SES to better understand which might be the most effective way to communicate to this target group about healthy and sustainable eating (HSE). To address this aim, we used a combination of qualitative and quantitative research methods and conducted two studies with people who have been stricken by poverty (the beneficiaries of social supermarkets of the Caritas food charity in Italy). In Study 1, focus groups were conducted with customers and professionals of the Caritas association to explore information needs and preferences of consumers of low SES with respect to HSE. Based on these findings, communication materials (i.e., infographics) were developed and tested in a larger sample of Caritas customers via an online survey (Study 2). Consumers of low SES experience food insecurity (and the mental/psychological burden that accompany it), the lack of trust on the sources of information, and language/cultural barriers (for immigrants), which prevent them from using information about HSE. However, limited interest in HSE or contextual factors such as the lack of cooking skills/equipment or a limited access to fresh food also play a role in the limited uptake of HSE. Information material aiming at increasing motivation (e.g., the benefits of HSE on health or the environment), capability (e.g., flexible recipes with HS foods), and opportunities (e.g., access to HS foods that are affordable) for HSE are currently being tested, and the results will be available in October 2023. The results of this research will be used to develop a toolkit with evidence-based recommendations on how to best communicate about HSE with consumers of low SES.

Keywords: healthy eating; sustainable eating; low socio-economic status; health communication; mixed methods

Author Contributions: Conceptualization, B.C. and A.P.; methodology, A.P., B.C. and N.M.; formal analysis, A.P.; writing—original draft preparation, A.P.; writing—review and editing, B.C. and N.M.; visualization, A.P. and B.C.; supervision, B.C.; funding acquisition, B.C. and N.M. All authors have read and agreed to the published version of the manuscript.

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A North–South Comparison of Commercially Produced Foods Sold in European Public Universities [†]

Naiara Martinez-Perez ^{1,*} , Liv Elin Torheim ² , Miriam Baeta ³, Iñigo Olalde ^{4,5} and Marta Arroyo-Izaga ⁶ 



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Keywords: university food; food environment; nutrient profile model; food processing level; public health

Background and objectives: University food environments (FEs) play a crucial role in preventing nutrition-related diseases. However, there is a lack of in-depth studies on these environments, especially those comparing different sociocultural contexts. Thus, we analysed the availability and characteristics of commercially produced food supplies between a Northern European and a Southern European university.

Methods: We conducted a cross-sectional observational study at OsloMet (Oslo Metropolitan University, Norway) and the University of the Basque Country (UPV/EHU, Spain). A nutritional quality assessment of food products was carried out using three nutritional profile models (NPMs), those developed by the Spanish Agency for Consumption, Food Safety and Nutrition (AECOSAN), the UK nutrient profiling model (UK NPM), and the Norwegian Food and Drink Industry Professional Practices Committee (Matbransjens Faglige Utvalg [MFU]), as well as a combination of these models. Additionally, food items were categorized according to processing level (NOVA system).

Results: The percentage of foods classified as having low nutritional quality (LNQ) was significantly higher at the UPV/EHU (54.5% of total products) compared to OsloMet (40%) ($p < 0.001$). The majority of the products offered were categorized as ultra-processed. However, there were no significant differences in the proportion of ultra-processed foods between the two universities (OsloMet: 86.1%, UPV/EHU: 83.3%, $p > 0.05$). **Discussion:** This study reveals North–South differences in terms of the availability of LNQ food products, with a higher proportion in the Southern university. This result agrees with the opinion of the university community about these FEs; more students and staff from OsloMet considered that they are usually able to choose “healthy” foods compared to those from the UPV/EHU [1,2]. These findings underscore the need for the development of interventions and policies that promote healthier campus FEs and consider sociocultural contexts.

Author Contributions: Conceptualization, N.M.-P., L.E.T. and M.A.-I.; investigation (data collection), N.M.-P. and L.E.T.; formal analysis, N.M.-P. and M.A.-I.; writing – original draft, review & editing, N.M.-P., L.E.T., M.B., I.O. and M.A.-I.; supervision, L.E.T. and M.A.-I.; funding acquisition, N.M.-P. and M.A.-I. All authors have read and agreed to the published version of the manuscript.

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Micronutrient Content of Plant-Based Meat Alternatives Available in the UK and Ireland: Product Audits (2021 and 2023) [†]

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Abstract: Knowledge of micronutrient content of commercial plant-based meat alternatives (PBMA) is limited. This study aimed to identify changes in micronutrient content of PBMA over time, as well as how micronutrient levels of PBMA compare to similar meat products using product audit data. An online audit of PBMA in Tesco and Sainsbury's was conducted in 2021 and 2023. On-pack information was extracted and inputted into Excel. Products were categorised, with categories containing on-pack micronutrient content for ≥ 2 products compared with similar meat products using data from Nutritics software and descriptive statistics applied. Nutrient claim thresholds were used to determine how many PBMA were eligible to make a 'source of' or 'high in' claim for vitamin B12 ($\geq 0.38 \mu\text{g}$ and $\geq 0.75 \mu\text{g}/100 \text{g}$, respectively) and iron ($\geq 2.1 \text{mg}$ and $\geq 4.2 \text{mg}/100 \text{g}$, respectively). Results: Around 7% of products ($n = 23/351$ in 2021 and $n = 22/324$ in 2023) reported vitamin B12 content on-pack and 8% of products reported iron content on-pack ($n = 28/351$ for 2021 and $n = 25/324$ for 2023). All products contained levels adequate to make a 'source of' claim, with around 22% (2021) and 41% (2023) of these products eligible to make a 'high in vitamin B12' claim and 14% (2021) and 28% (2023) eligible to make a 'high in iron' claim. Median vitamin B12 and iron content/100 g was higher in 2023 products for 5/6 and 4/5 categories, respectively, with no change in the other category. For 2023 data, PBMA had lower mean vitamin B12 contents/100 g in 4/6 categories compared to meat products (0.6–1.8 μg for PBMA vs. 0.0–3.0 μg for meat products). For all six categories (burgers, mince, beef, pork, chicken, and lamb), PBMA had higher mean iron contents/100 g than comparable meat categories (2.8–6.8 mg for PBMA vs. 0.4–2.7 mg for meat products). Magnesium, zinc, calcium, vitamin A, and folic acid contents were listed on ≤ 1 product per category. Discussion: Vitamin B12 and iron contents of the PBMA included in these audits appear to be increasing over time, however, levels of vitamin B12 need to increase to equate to those of red meat. Further fortification represents an option for improving the micronutrient profile of PBMA to reflect levels in comparable meat products.

Keywords: plant-based meat alternatives; plant-based meat analogues; micronutrients



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A Brief Bibliometric Analysis of Microplastic and Nanoplastic Particles in Food †

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Teofilovic, V.; Stojic, N. A Brief Bibliometric Analysis of Microplastic and Nanoplastic Particles in Food.

Abstract: Microplastic and nanoplastic particles have gained significant attention in recent years due to their potential presence in various environmental matrices, including food. This bibliometric analysis aims to explore the scientific landscape surrounding the study of microplastic and nanoplastic particles in food, shedding light on key research trends, prominent authors, and notable journals in this field. To conduct this analysis, a comprehensive search was performed on scholarly databases, including Web of Science, PubMed, and Scopus, using relevant keywords such as “microplastic”, “nanoplastic”, “food”, and related terms. The analysis focused on peer-reviewed articles published between 2020 and 2023. The search found 313 articles on microplastic and nanoplastic particles in food, indicating a growing interest in this research area. The number of publications showed an upward trend, with the most productive year being 2020 (38% of papers), followed by 2023 and 2021 (23% each). In 2020, 16% of papers were published. Among the analyzed articles, 48% were original research papers, 46% were reviews, and the remaining 6% included book chapters, perspectives, and other publications. The analysis revealed that the most prolific authors in this field include researchers such as Jansen, M.A.K., Abbasi, S., and Banerjee, A., who have significantly contributed to the study of microplastics and nanoplastics in food. Additionally, several collaborations between different research institutions were observed, emphasizing the multidisciplinary nature of this research area. Furthermore, the analysis identified key journals publishing research on microplastics and nanoplastics in food, including *Science of the Total Environment*, the *Journal of Hazardous Materials*, and *Environmental Pollution*. The increasing number of publications on microplastic and nanoplastic particles in food indicates the growing awareness and concern regarding the potential risks associated with these contaminants. This bibliometric analysis provides insights into the scientific landscape of microplastic and nanoplastic particles in food. The analysis demonstrates the upward trajectory of research in this field, identifies influential authors, and highlights the significant role of specific journals. Continued research and collaboration are essential to further our understanding of the impacts of microplastics and nanoplastics on food safety and human health, facilitating the development of effective mitigation strategies.

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Newtools—Developing New Tools for a Sustainable Food System, Including Two Scoring Systems for Foods on Nutritional Quality and for Environmental and Social Sustainability [†]

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Abstract: Background and objectives: Today, enough food is produced in the world, but much of the food produced and offered has poor nutritional quality, is unevenly distributed, or requires a lot of natural resources. To achieve a more sustainable food system, there is a need for simple tools to guide consumers, food producers, politicians, etc. towards more sustainable foods and diets. The main aim of the NewTools project is to develop two new scoring systems for foods; one that indicates nutritional quality, and one that indicates environmental and social sustainability, and to explore potential areas of application. Methods: In the research project NewTools (2021–25), 28 different actors in the Norwegian food system are partners and represent research institutions (7), food industry (13), governmental agencies (3), and non-governmental organizations (5). Building on existing knowledge and scoring systems, the project will first work to identify relevant indicators for being included in the scores. Indicators should be evidence based, measurable, and reasonably easily accessible. The indicators shall then be weighted according to their relative importance into the aggregated scores. NewTools also facilitates co-creation so that possible uses for the scores can be identified and tested. Research integrity is ensured by following a predefined framework for cooperation. Results: Until now, the evaluation of the newly revised Nutri-Score in a Norwegian setting has revealed several potential areas of improvement. We have defined a set of criteria for a nutrition quality score that will better align with food-based dietary guidelines, and a prioritized list of gaps compared to the Nutri-Score. For environmental and social sustainability, we are currently mapping relevant indicators with input from the literature and food system actors. Discussion: NewTools is a research project and a platform for broad collaboration that can contribute to the development of effective tools for shifting the food system towards a more sustainable direction, including more dimensions of sustainability compared to the European “product environmental footprint” (PEF).

Partners representing governmental agencies, the food industry, and non-governmental organizations (NGOs) contribute information, critical perspectives, data, and feedback, and their involvement is important to ensure that different perspectives are included.

Keywords: nutrient profiling; sustainability; scoring systems for foods

Author Contributions: Conceptualization, Methodology and Funding Acquisition of the NewTools Project, H.M.M., M.H.A., H.F.O., T.A.Y. and K.I.K.; Writing Abstract—Original Draft Preparation,

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How Is the Promotion of Sustainable Diets Addressed in Austrian Policies? †

Ursula Trübswasser *, Theres Rathmanner and Barbara Wondrasch



Citation: Trübswasser, U.; Rathmanner, T.; Wondrasch, B. How Is the Promotion of Sustainable Diets Addressed in Austrian Policies?

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Keywords: sustainability; nutrition; policy

Background and objectives: There is growing emphasis on the need to ensure that our food systems and diets are more sustainable, which is important for achieving the UN's Sustainable Development Goals [1]. Meat production contributes to global environmental problems and excessive meat consumption has also been associated with health problems like cardiovascular diseases, diabetes type II and obesity [2]. Current consumption quantities, especially in Western countries like Austria, exceed dietary recommendations. On average, a person consumes 88.2 kg of meat per year [3] instead of the recommended 23 kg per person per year [4]. A supporting policy framework is needed to make food production more sustainable and contribute to more sustainable diets. Our study therefore aimed to analyse Austrian policies with regard to policy actions targeting sustainable diets.

Methods: This policy analysis used existing frameworks encompassing the different dimensions of sustainable diets grouped into 4 key impact behaviors: (1) reducing consumption of meat and animal foods and increasing plant-based foods; (2) reducing the consumption of unhealthy foods, i.e. those that are high in fat, salt and sugar or ultraprocessed foods; (3) increasing the consumption of organic foods and (4) reducing food waste at household level [5]. Sustainability frameworks have been applied to policy analysis previously [6]. Policy documents were sought from government websites of ministries and institutions related to food, health, nutrition, sustainability, and agriculture. In addition, representatives of different ministries or governmental institutions were contacted to collect further documents. The documents had to be outputs of decision-making in the form of published strategies, plans or policies and should include legal outputs and sectoral documents proposing policy actions to implement policy goals [7]. Each document underwent content analysis and was coded by two researchers to examine how the different components of the sustainable diet framework were addressed.

Results: This analysis included 30 documents, which were published by different sectors: health (n = 10), agriculture (n = 8), climate (n = 5), food safety and nutrition (n = 5), and one document from the education sector. The most proposed policy action related to the 4 key behaviors was related to reduction of unhealthy foods, followed by increasing consumption of organic foods. In addition to the key behaviors, we identified promoting the consumption of regional and seasonal foods as the most dominant, which cut across all government sectors.

Discussion: Our study found a strong sectoral divide in the types and numbers of behaviors that were promoted. Actions related to consumption and production were still considered as separate sectoral responsibilities. There is a need to shift the attention to more systemic, inclusive and participatory approaches that require coherent and inclusive policy actions across different sectors, actors and population groups addressing consumption as well as production of sustainable foods through a variety of tools that go beyond the responsibility of the individual.

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Greenhouse Gas Emissions from Food Consumption: Results from the Icelandic National Dietary Survey 2019–2021 [†]

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Abstract: Food is one of the main drivers of global greenhouse gas (GHG) emissions. Therefore, it is crucial to investigate the environmental impact of food choices. A National Dietary Survey (NDS) is executed every ten years in Iceland. However, the dietary carbon footprint (DCF) based on the results from the NDS has not been estimated for Iceland before. Thus, the objective was to assess the DCF of dietary habits of adults living in Iceland. A carbon footprint modelling tool was implemented using data from three independent LCA databases from Denmark, the US, and France. The DCF was calculated using results from the latest NDS, including data from 2019 to 2021. This was a random study sample of 18–80 year old inhabitants living in Iceland with 822 participants, including 428 (52%) females and 394 (48%) males. The participation rate in the NDS was 51%. The average total DCF from the three databases was 5.7 kg CO₂-eq/day. The highest emissions originated from the consumption of meat and meat products (49%) (median intake 850 g/week) and dairy products (15%) (median intake 250 g/day), while emissions from the consumption of seafood (median intake 130 g/week) had a broader range (3–10%). Beverages also contributed to a significant proportion (12%), plant sources contributed 3%, and other food groups combined contributed 13% of the DCF in all three databases. The DCF for the participants following the Planetary Health Diet, the Nordic Nutrition Recommendations, and the Danish food-based dietary guidelines for intake levels of meat and dairy products was an average of 2.6 kg CO₂-eq/day. The main driver of GHG emissions from food consumption, identified by the three databases, was meat and dairy products, contributing to an average of 64% of the total DCF. When estimating the DCF for participants following recommendations for meat and dairy consumption, a similar pattern emerged, where the DCF decreased from 5.9–2.6 kg CO₂-eq. These consistent results suggest that uncertainties in estimating the DCF from different food groups using the three databases are not critical in identifying key drivers of GHG emissions.

Keywords: national dietary surveys; food consumption; life cycle assessment; greenhouse gas emissions; environmental impact; food based dietary guidelines

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Author Contributions: investigation, R.G., I.G., B.E.B. and P.I.H.; resources, R.G.; data curation, R.G., I.G., B.E.B. and P.I.H.; writing—Conceptualization, R.G., Ó.G.G., M.G., B.E.B., Ó.Ö. and P.I.H.; original draft preparation, R.G.; writing—review and editing, I.G., Ó.G.G., M.G., B.E.B., Ó.Ö. and P.I.H.; supervision, Ó.G.G., M.G., B.E.B., Ó.Ö. and P.I.H.; project administration, P.I.H.; funding acquisition, R.G., Ó.G.G., M.G., B.E.B., Ó.Ö. and P.I.H. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data can be shared on request conditioned on the purpose of use and privacy restriction.

Conflicts of Interest: The authors declare no conflict of interest.

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Assessing the Nutritional Quality of the Plant-Based Component of the Adult Diet in Ireland [†]

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Keywords: Plant-based diets; nutritional quality; food consumption database

Plant-based (PB) diets are varied and are not always of high dietary quality [1]. Within primarily omnivorous populations, understanding the nutritional quality of the PB component of the diet is important [2]. This study aimed to use data from the nationally representative National Adult Nutrition Survey (NANS) in Ireland to examine the nutritional quality of the PB component of the adult diet compared to the diet consumed by the NANS population (baseline diet). Food intake data were collected using a 4-day semi-weighed diary from 1500 adults (18–90 y) in the NANS (2008–2010). Nutrient intakes were estimated using UK and Irish food composition databases. All food and beverages consumed in the NANS were categorised into two extremes of PB diet definitions: Plantbased (all) (PB-A) and Plant-based (healthful) (PB-H) [2]. Energy-adjusted nutrient intakes (%E or /10 MJ) from the PB-A, PB-H and baseline diets were estimated. Differences in mean daily intakes of nutrients between the PB-A, PB-H and baseline were assessed via independent sample *t*-tests using SPSS® v26. Compared to the baseline diet, both PB-A and PB-H were of better nutritional quality for total and saturated fat, carbohydrate, dietary fibre, vitamin C, thiamin, folate, sodium, potassium and iron but of poorer quality for protein, MUFA, PUFA, vitamin D, vitamin B12, calcium and iodine (PB-A only). For free sugars and zinc, PB-A was of poorer nutritional quality compared to the baseline diet, but PB-H was of better quality. Comparing PB diet components, PB-H was of better nutritional quality compared to PB-A for total fat, saturated fat, PUFA, protein, carbohydrate, dietary fibre, free sugars, B-vitamins, vitamin C, potassium and iron but was of poorer quality for vitamins D and B12. Transitioning to a more PB diet may improve the nutritional quality of the diet in terms of several key nutrients but may also lead to potential deficiencies in others, including vitamins D and B12. Comparing these findings with future food consumption data will identify PB diet trends among adults in Ireland.

Author Contributions: Conceptualization, L.K. and J.W.; methodology, G.K., L.K. and J.W.; formal analysis, G.K.; data curation, G.K.; writing—original draft preparation, G.K., L.K. and J.W.; writing—review and editing, G.K., L.K., B.M., A.N., A.F. and J.W.; visualisation, G.K.; supervision, A.F., L.K. and J.W.; funding acquisition, A.N., A.F., B.M. and J.W. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available from the corresponding author upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

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Composition of Nguni Goat Meat—An Underutilised Indigenous Food

†

Zani Veldsman ^{*}, Beulah Pretorius ¹ and Hettie Schönfeldt ¹



Citation: Veldsman, Z.; Pretorius, B.; Schönfeldt, H. Composition of Nguni Goat Meat—An Underutilised Indigenous Food. *Proceedings* **2023**, *91*, 237. <https://doi.org/10.3390/proceedings2023091237>

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Abstract: Introduction: Diets lack diversity, and the consumption of a few energy-dense cash crops is increasing. Nguni goats are an

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underutilised, indigenous source of red meat in sub-Saharan Africa. They survive in semi-arid and arid areas with little to no agricultural input. The nutritional contribution of Nguni goat meat is not well researched and documented from a food and nutrition security perspective. Objective: To determine the composition of Nguni goat meat, in comparison with other red meat species in the South African diet, focusing on the fatty acid profile. Method: The nutritional analyses, including the proximate analysis, minerals, and the fatty acid profile of Nguni goat meat from three different regions in South Africa, was performed and compared with other red meat species in the diet. Results: Values reported for moisture (74.2 g/100 g), ash (1.02 g/100 g) and protein (19.5%) are similar to other sources of red meat, with the total fat content (4.4%) being slightly lower. Nguni goat meat is a good source of iron (2.89 mg/100 g) and zinc (4.02 mg/100 g). Furthermore, the values reported for saturated fatty acids (2.55 g/100 g), monounsaturated fatty acids (1.51 g/100 g), polyunsaturated fatty acids (0.36 g/100 g) and cholesterol (5 mg/100 g) content of indigenous goat meat were lower than other red meat species. However, the percentage of saturated fatty acids (57.7%) and monounsaturated fatty acids (34.2%) to total fat is similar to other red meat sources but higher for polyunsaturated fatty acids (8.14%). Stearic acid (C18:0) (1.10 g/100 g) is the most prevalent saturated fatty acid, elaidic acid (C18:1t9) (0.11 g/100 g) is the most prevalent monounsaturated fatty acid and linoleic acid (C18:2 n6) (0.23 g/100 g) is the most prevalent polyunsaturated fatty acid. The omega-3 fatty acids and omega-6 fatty acids content is 0.07% and 0.25%, respectively. The majority of the PUFA's is linoleic acid (C18:2 n6) and is similar to values reported for beef. Conclusions: Goat meat is a nutritious underutilised indigenous, food source that can contribute toward increasing dietary diversity, thereby improving nutrition and food security in sub-Saharan Africa.

Keywords: Nguni goat meat; nutritional composition; fatty acid profile; indigenous food

Author Contributions: Conceptualization, Z.V., B.P. and H.S.; methodology, Z.V., B.P. and H.S.; software, Z.V.; validation, Z.V., B.P. and H.S.; formal analysis, Z.V.; investigation, Z.V.; resources, Z.V.; data curation, Z.V.; writing—original draft preparation, Z.V.; writing—review and editing, Z.V., B.P. and H.S.; visualization, Z.V.; supervision, B.P. and H.S.; project administration, Z.V.; funding acquisition, Z.V. and B.P. All authors have read and agreed to the published version of the manuscript.

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How Will Chemistry Help Solve World Hunger? [†]

Miroslav M. Vrvic ¹, Srdjan Miletic ²  and Nikoleta Lugonja ^{2,*} 



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Abstract: World hunger remains a pressing global issue that

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demands innovative solutions to ensure food security and alleviate widespread malnutrition. In this context, the role of chemistry in addressing the complex challenges of food production, preservation, and distribution is crucial. Chemistry has the potential to play a significant role in addressing the global issue of world hunger. Through the development of innovative agricultural practices, food preservation technologies, and novel food sources, chemistry can help increase the global food supply and ensure that all people have access to nutritious and affordable food. This paper explores the various ways in which chemistry is being used to tackle world hunger, from the production of drought-resistant crops to the development of sustainable farming methods. The paper also discusses the challenges that must be overcome to fully leverage the potential of chemistry in addressing world hunger, including the need for investment in research and development, as well as greater collaboration between scientists, policymakers, and other stakeholders. Ultimately, this paper argues that chemistry can be a powerful tool in the fight against world hunger and that continued investment in this field has the potential to make a significant impact on global food security. Chemistry plays a fundamental role in improving agricultural practices and increasing crop yields. Through the development of fertilizers, pesticides, and herbicides, chemists can optimize plant growth, enhance soil fertility, and combat pests and diseases that threaten agricultural productivity. Moreover, advancements in genetic engineering and biotechnology allow scientists to create genetically modified organisms (GMOs) as potential food. In conclusion, chemistry holds immense potential in addressing the challenges of world hunger. By leveraging its principles and technologies, including agricultural innovations, food preservation techniques, fortification strategies, and sustainable practices, chemistry can contribute to increasing food production, improving nutrition, and ensuring food security for vulnerable populations. However, it is crucial to prioritize ethical considerations, sustainability, and equitable access to these advancements to ensure a comprehensive and inclusive approach to solving world hunger.

Keywords: chemistry; food production; world hunger

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Legumes and Nuts/Seeds Consumption of Adults Living in Türkiye: A Cross-Sectional Study [†]

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Abstract: Sustainable nutrition is becoming increasingly popular as a strategy for ensuring food production and consumption with environmental, social, and economic sustainability. Current studies show the need for a plant-based diet to reduce greenhouse gas emissions and improve population health. In this preliminary cross-sectional study, the consumption of legumes and nuts/seeds of adults living in Turkey was investigated. A total of 3624 adults (50.8% were women) were included in the study. Legumes and nuts/seeds consumption frequencies, consumption patterns and one-day food consumption records were taken. Of the individuals, 44.4% were of a normal weight, 36.7% were overweight and 15.1% were obese. Legumes were preferred by 57.4% for lunch and by 40.8% for dinner, and nuts/seeds were preferred by 72.7% for snacks. Every fortnight, 36.4% of the individuals consumed beans, 27.9% consumed peas, 20.4% consumed red kidney beans, 25.4% consumed green lentils and 34.6% consumed chickpeas. Red lentils were the most frequently consumed legumes, with 81.1% of the study participants consuming them once every fifteen days or more. The average monthly consumption of beans was 274.78 ± 245.17 g, for red lentils, it was 232.43 ± 270.13 g and for chickpeas, it was 246.52 ± 233.55 g. Legumes were consumed at least once a week as 75.9% soup, 65.2% as a main/side dish, and dried nuts 86.1% as snacks. The most consumed nuts/seeds over 100 g per month were sunflower seeds, pumpkin seeds, raw hazelnuts, roasted hazelnuts, and roasted chickpeas. The next step is to investigate the factors affecting the current consumption types and amounts of these food groups with regression analysis, which will constitute the most important building block of a healthy diet within the framework of sustainable nutrition.

Keywords: legumes; nuts; sustainability; plant-based diet



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Perception and Consumption of Organic Food in a Group of Organic and Conventional Fruit Growers—A Pilot Study (CO-FRESH Project) [†]

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Abstract: Background and Objectives: The organic farming system takes a restrictive approach to cultivation, production and food processing techniques, resulting in a product that is richer in selected nutrients with less contamination. The aim of our study was to assess the consumption and perception of organic food by orchardists in organic and conventional production. Methods: A total of 58 orchardists took part in the study of which 31 were from an organic farm and 27 were from a conventional farm. Respondents had their height and weight measured. The study used a self-administered questionnaire in which the respondents stated the percentage of their food that came from organic farming as well as which food groups they consumed in the organic version. Respondents compared organic and conventional products in terms of taste, smell, appearance, texture, composition, shelf life and overall quality. Results: The median age of the study group was 44 years and the mean BMI was 28.22 ± 4.3 kg/m². No differences were observed between organic and conventional orchardists ($p > 0.05$). Forty-three participants in the study consumed organic food, most for more than 3 years ($n = 31$). The proportion of organic products in the diet of organic orchardists was mostly 20–40%, and in that of conventional orchardists the proportion was <20%. Organic fruit growers consumed organic food more often and in higher amounts ($p < 0.001$). Eggs as well as fruit and vegetables were the most commonly consumed in the organic version. Both organic and conventional growers rated organic food as having better taste, smell, texture, composition and overall quality but poorer appearance and shelf life compared with conventional food. Organic farmers rated the taste and smell ($p < 0.001$), texture ($p = 0.02$) and composition ($p = 0.002$) to be significantly better. No differences were observed between the groups in the evaluation of appearance, shelf life and overall quality ($p > 0.05$). In both subgroups, organic food was collectively rated as better than conventional food. However, organic fruit growers rated it to be better than the conventional ones ($p < 0.001$). Participants eating more organic food rated it to be significantly better ($p < 0.001$). Discussion/Conclusions: Organic food was rated to be better compared with conventional food. Organic orchardists rated organic food to be better and consumed it more compared with conventional orchardists. Better organic food ratings resulted in more frequent consumption across a greater variety of products.

Keywords: orchardists; organic food; consumption; organic food perception; Poland



Citation: Dobrowolski, H.; Obidzin´ska, J.; Rembiałkowska, E.; Kazimierczak, R.; Włodarek, D. Perception and Consumption of Organic Food in a Group of Organic and Conventional Fruit Growers—A Pilot Study (CO-FRESH Project). *Proceedings* **2023**, *91*, 225. <https://doi.org/10.3390/proceedings2023091225>

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Micronutrient Intakes and Status in the Protein Transition: A Systematic Review [†]

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Abstract: A food systems transformation is required to improve both human and planetary health. A reduction in the consumption of high-impact animal-based foods will be necessary, especially in high-income settings. Ensuring nutritional adequacy in this transition is critical, as animal-based foods are dense sources of many micronutrients. This review systematically summarised the available literature to assess the impact of reducing the environmental impact of diets, through the transition from animal to plant-based protein, on intakes and status of vitamins A, D, and B12, folate, calcium, iron, iodine, and zinc. The PRISMA guidelines were followed, and a review protocol was prospectively registered with PROSPERO [CRD42021239713]. Seven databases were searched for studies published between January 2011 and October 2022. Independent screening of titles and abstracts and a review of the full-text articles were completed by two reviewers. Fifty-six studies met the inclusion criteria, mainly from high-income countries ($n = 49$). Most studies were based on the modelling of dietary data ($n = 45$). Ten studies stratified observational data using an environmental outcome, and there was one randomised controlled trial (RCT). The RCT compared three levels of plant protein intake; intakes and status of vitamin B12 and iodine decreased significantly in the group with the highest proportion of plant protein. None of the other studies reported on nutritional status. Intakes of zinc, iron, calcium, and vitamins D, B12, and A were lower in observed diets with lower greenhouse gas emissions, and diets with a higher plant protein intake showed similar results, except iron was higher. Iron was also higher in diets adhering best to the EAT-Lance guidelines; however, heme iron reduced in one study. Vitamin B12 and zinc were consistently lower in diets modelled to reduce environmental impacts, while some studies found lower levels of vitamins A and D as well as calcium, which was influenced by fortified foods. Dietary optimisation of existing representative data showed that meeting nutritional, environmental, and cost constraints is technically feasible, supporting all components of a sustainable diet. This review highlights the need for high-quality intervention studies reporting biomarkers of nutritional status to pave the way for evidence-based strategies to promote both human and planetary health.

Keywords: sustainable diets; micronutrients; dietary intake; nutritional status; environmental impact; dietary change; public health

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Environmental Impact and Food Consumption among Current Diets and Alternative Dietary Scenarios Worldwide: A Systematic Review [†]

Aliki Kalmpourtzidou *^{ID}, Beatrice Biasini, Alice Rosi ^{ID} and Francesca Scazzina ^{ID}



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Environmental Impact and Food Consumption among Current Diets and Alternative Dietary Scenarios Worldwide: A Systematic Review.
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Abstract: Diets characterized by a relatively high caloric and animal-based protein content have a negative impact on both human health and the environment. Unhealthy and unsustainable diets with a high content of meat and low intake of plant-based products are predominant worldwide. A balance between health and sustainability is necessary since diets that are environmentally

sustainable could lack macro- and/or micronutrients and result in nutrient deficiencies. A systematic review was conducted following PRISMA guidelines to analyse the environmental impact and the food group consumption of current diets and alternative dietary scenarios worldwide. Scopus, Web of Science and PubMed were searched. The initial systematic search yielded 5639 publications. The final dataset was composed of full-length original studies in the English language conducted from 2000 onwards. Studies conducted on general, free-living populations aged ≥ 18 years old were included. In total, 120 original articles from 41 countries globally were included, and 703 diets and dietary scenarios were extracted. The majority of studies/surveys were considered as nationally representative (68%). Current diets were the most prevalent (42%), while optimized dietary scenarios accounted for 29% of the studies. Among the environmental indicators, the carbon footprint was the most reported (86% of dietary scenarios), followed by the use of land (36%), total freshwater (22%), blue water (15%) and energy (14%). Diets were further divided into main diet categories based on their description after data extraction. The environmental impact and the food consumption of dietary scenarios varied widely between diets and between continents and continental regions due to the methodological heterogeneity in dietary assessments and the different definitions of diets and food groups. As expected, vegan diets reported the lowest GHGEs impact (0.3–2.6 CO₂ eq/d); however, their healthiness and their nutrient efficiency were not analysed due to the underreporting of the nutritional composition of the dietary scenarios in these studies. Specific dietary scenarios performed strongly regarding carbon footprint, but poorly for other environmental impact factors; thus, diets' impacts should be holistically analysed through multiple environmental indicators. Data on food consumption and environmental impact are available only for a small part of the world. Extensive research on dietary intake and environmental impact in low- and middle-income countries is needed.

Keywords: dietary scenarios; food sustainability; environmental impact; alternative diets

Author Contributions: Conceptualization, A.K., B.B., A.R. and F.S.; methodology, A.K., B.B., A.R. and F.S.; studies screening, A.K. and B.B.; data extraction, A.K.; formal analysis and data curation, A.K.; writing original draft preparation, A.K.; writing, review and editing, A.K., B.B., A.R. and F.S. All authors have read and agreed to the published version of the manuscript.

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Food Biodiversity and Diet Quality in Dutch Adults [†]

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Abstract: Biodiversity is essential for human and environmental health, yet our food system is one of the primary drivers of biodiversity loss. Food biodiversity, defined as the variety of consumed plants, animals and other organisms, can be measured by Dietary Species Richness (DSR). A higher DSR is associated with a lower mortality risk in European populations; however, less is known about DSR and diet quality in Dutch populations. We assessed the associations between fruit DSR and diet quality in a representative sample of 2078 Dutch participants aged from 19 to 79 years. Data were retrieved from the Dutch National Food Consumption Survey (DNFCS) between 2012 and 2016 by two non-consecutive 24 h diet recalls. Fruit DSR was calculated based on the absolute count of unique fruit species consumed over two measurement days, regardless of the total amount (grams) of consumed fruits. The Dutch Healthy Diet index 2015 (DHD15-index) consisting of 14 components was used to measure diet quality. Per component, participants could score between 0 and 10, with a total score between 0 and 140. Linear regression analyses were performed to investigate the association between fruit DSR and DHD15-index. Analyses were stratified by age and sex and corrected for total energy intake. In total, 45 (DSR fruit: median 2 [IQR 1–3]) different fruit species were consumed by 2078 participants in this sample. On average, participants consumed 260 g of fruit (SD265) over two days. *Malus domestica* (apple) was the most frequently consumed species (23.9%), and 462 participants (22.2%) did not consume any fruits. Overall, moderate scores for diet quality were found (DHD15-index: M59; SD18; min–max11–115) and females seem to have healthier diets than males. For every additional fruit species consumed, the DHD15-index score increased by 4.17 points (95%CI 3.79–4.54). The strongest associations between DSR fruit and DHD15-index were found in Dutch adults between 19 and 30 years (β 4.7 [95%CI 3.9–5.5]). Fruit DSR was associated with diet quality. Every additional consumed fruit species led to a higher DHD15-index score. This is in line with previous studies, but further research in this sample is needed to explore if these associations also exist between overall DSR and diet quality. This research is ongoing.



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The Effect of Nature-Based Solutions on Human Nutrition and Food Security in Urban Settings [†]

Aliki Kalmpourtzidou ^{1,*} , Rachele De Giuseppe ¹ , Alessandra Vincenti ¹, Ghanya Al-Naqeb ¹
and Hellas Cena ^{1,2} 



Citation: Kalmpourtzidou, A.; De Giuseppe, R.; Vincenti, A.; Al-Naqeb, G.; Cena, H. The Effect of Nature-Based Solutions on Human Nutrition and Food Security in Urban Settings. *Proceedings* **2023**, *91*, 214. <https://doi.org/10.3390/proceedings2023091214>



Abstract: Increased land use as a result of urbanization is one of the most rapid human-driven causes of biodiversity loss. Urbanization negatively affects human health because of poor nutrition, non-communicable diseases (NCDs) and health problems related to air pollution. Nature-based solutions (NbSs) for sustainable food production in combination with reduced land and water use are essential for the reduction in biodiversity loss, human health and nutrition. This systematic review aims to assess the effects of NbSs that positively contribute to biodiversity on human health and wellbeing in urban settings worldwide. Secondly, other factors, such as safety, attractiveness, inequity and accessibility, that may have a potential role in the use of NbSs will be evaluated. For the purpose of the FENS conference, only results related to nutrition and food security will be presented. The PRISMA guidelines will be followed. Full-length articles in English language conducted in

2000 and published in 2010 will be included. Both quantitative and qualitative studies are eligible. Due to the diversity of studies, the quality assessment with diverse studies (QuADS) tool will be used for the quality assessment of the studies included. The statistical analysis will depend on the heterogeneity and the feasibility of harmonization of the data. PubMed, Web of Science and Scopus were searched. The initial search yielded 14386 publications. After the removal of duplicates, 8730 titles and abstracts were screened. Currently, 881 full texts out of 2928 have been screened, from which 69 (8%) studies reported outcomes related to human nutrition and food security. Most of the studies took place in urban gardens (61%). Urban farming (25%) and farmers' markets followed (25%). Vegetation/greenness in cities was considered as an NbS by 6% of the studies. Less studied NbSs were green roofs, general green spaces, urban foraging and urban blue spaces (3% each). Gardening has been shown to be beneficial for the wellbeing and nutrition of various populations. Due to the high land use for the feeding of urban populations, alternative food production techniques without soil use are important. Soil-free rooftop farms and vertical farming could increase the vegetable and fruit production in cities and improve the diet quality of citizens.

Keywords: nature-based solutions; urban gardening; nutrition; food security; urban; city

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Association between the Planetary Health Diet Index and Cardiovascular Health Status among European Adolescents: The HELENA Study [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023. [‡] Thais De Ruyter will be the presenting author.

Abstract: Background: The EAT-Lancet Commission proposed a global reference diet to promote healthy diets within planetary boundaries. Recently, the Planetary Health Diet Index (PHDI) was proposed to evaluate the adherence to the EAT-Lancet diet, and it has been validated among European adolescents. However, studies evaluating the associations between the PHDI with health outcomes among adolescents are lacking. Thus, our aim was to assess the association between adherence to the EAT-Lancet diet—through the PHDI score—and cardiovascular health among European adolescents. Methods: Data from the Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) study were used. Usual dietary intake was assessed using two 24 h dietary recalls, and adherence to the

EAT-Lancet diet was assessed using the PHDI, a 16-component index that ranges from 0 to 150 points. Cardiovascular health was assessed through the seven-component Ideal Cardiovascular Health (ICH) score, the seven components of which are as follows: never smoked, eutrophic body mass index, moderate to vigorous physical activity, healthy dietary pattern, low blood pressure, low fasting plasma glucose, and low total cholesterol. Total ICH scores were categorized into ideal (5–7) and non-ideal (0–4). Logistic regression models were fitted to evaluate the association between the PHDI and ICH, and the model was adjusted for potential confounders, including age, sex, socioeconomic disadvantage/vulnerability score, and total energy intake. Results: A 10-point increase in the PHDI was associated with a lower probability of a non-ideal ICH status (OR 0.84, [95% CI: 0.75, 0.94]) among European adolescents in the adjusted model. Furthermore, a 10-point increase in the PHDI was associated with a lower probability of high blood pressure (OR: 0.87 [0.79, 0.96]) and a lower probability of high blood cholesterol (OR: 0.88 [0.78, 0.99]). Discussion: In the HELENA study, we found that higher adherence to the EAT-Lancet reference diet was positively associated with better cardiovascular health among European adolescents. Furthermore, adolescents with a higher PHDI were less likely to have high blood pressure and cholesterol.

Keywords: EAT-Lancet diet; sustainable diets; cardiovascular health; adolescents' health



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Author Contributions: Conceptualization, L.T.C., D.M.M., and L.A.M.; formal analysis, L.T.C.; investigation, L.T.C.; data curation, L.T.C. and I.H.; writing—original abstract, L.T.C.; writing—review and editing, L.T.C., I.H., G.T.H.-C., T.D.R., D.M.M., S.D.H. and L.A.M.; supervision, S.D.H. and L.A.M. All authors have read and agreed to the published version of the abstract.

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Institutional Review Board Statement: The HELENA study was approved by the Research Ethics Committees of each study site and followed the ethical guidelines of the Declaration of Helsinki 1964 (revision of 2000), good clinical practice, and the legislation about clinical research in humans in each one of the countries involved in the study in February 2006.




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Data Availability Statement: The data described in the manuscript can be made available upon request pending application and approval by the chair of the steering committee for the HELENA study. The analytic code of the PHDI computation will be made available upon request pending to the corresponding author.

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Understanding the Complexity of the Food System: Differences and Commonalities between Two Optimization Models [†]

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Abstract: Background and objectives: There is a compelling need for a more sustainable food system because of climate change and contemporary Western diets, which pose a threat to human and planetary health. The food system is a social–ecological system, consisting of both biophysical and social sub-systems which are interlinked. This implies that changes in one sub-system can lead to synergies and trade-offs elsewhere. To identify such synergies and tradeoffs, researchers are integrating work from a range of disciplines in optimization models. This has resulted in models that are unique but have a similar overarching aim: ‘to create a sustainable food system by understanding the implications of food system choices’. However, the results of these models may differ. Therefore, the aim of this paper was to understand the differences and complementarity of two optimization models to grasp the complexity of the food system. Methods: we compared the Circular Food System (CiFoS) model with the Sustainable, Healthy, Acceptable, Realistic, and Preferable diets (SHARP) model. CiFoS is a biophysical optimization model that aims to produce a healthy diet for a growing population within planetary boundaries. SHARP is a benchmarking model that optimizes current diets for health and sustainability for consumers. Both models propose a healthy and sustainable diet. While CiFoS is detailed on how environmental impacts are calculated, SHARP has a finer grid on the consumption aspects. Results: based on previously modelled scenarios that showed different results in diet composition, we identified that these differences could be explained by fundamental characteristics of the model (e.g., environmental impact calculations or the consideration of distance to the current diet), data input and scenario settings. Besides, the models work complementary regarding the time scale (i.e., solutions for the upcoming years versus upcoming decades), geographic scale and an individual versus population approach. Conclusion: Optimization models may be used for the same goal, e.g., finding an optimal diet, but the nuance chosen will lead to different outcomes. The outcomes of such models are complementary and can therefore be used in conjunction to inform policy or other food system stakeholders.

Keywords: CiFoS; SHARP; Sustainable food system; diet modelling; diet optimization; healthy and sustainable diet

Author Contributions: Conceptualization, S.N.H. and R.P.M.C.; methodology, S.N.H. and R.P.M.C.; formal analysis, S.N.H., R.P.M.C. and H.H.E.v.Z.; investigation, S.N.H. and R.P.M.C.; resources, H.H.E.v.Z. and S.B.; data curation, S.B. and H.H.E.v.Z.; writing—original draft preparation, S.N.H. and

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[request](https://www.rivm.nl/en/dutch-national-food-consumption-survey/data-on-request) (accessed on 16 October 2019). Primary environmental data of 250 food products can be found at <https://www.rivm.nl/voedsel-en-voeding/duurzaam-voedsel/databasemilieubelastingvoedingsmiddelen> (accessed on 16 October 2019). Raw data of the CiFoS model have been deposited in the GIT repository and are available on request under a license similar to Creative Commons Attribution-NonCommercial-Share A like 4.0 International Public License. A dashboard is available on www.circularfoodsystems.org providing detailed data related to the results of this publication.

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Switching towards More Plant-Based Diets in Older Adults: Implications for Protein Intake and Protein Quality Based on a Simulation Study [†]

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Abstract: Rationale: An adequate amount of good-quality protein (P) is essential to remain fit and healthy at an older age. Animal-based

proteins (ABPs) are of high quality and provide nearly 60% of the P intake in older adults. It is unclear if an adequate P intake can be achieved when ABPs are replaced by vegetarian (Veg) or plant-based (Plant) alternatives. Methods: A simulation study was performed based on dietary intake data from the Dutch National food consumption (DNFC) 2019–2021 (n = 607, age ≥ 65 years). In five scenarios, animal protein intake was replaced by vegetable protein. The scenario diets included vegetarian, flexitarian (two levels), pescatarian and vegan. Protein quality was measured by the Meal Protein Quality Score (MPQS), a score that ranges from 0–100 and takes into account protein digestibility, body-weight based amino acid requirements, and time window of complementation. Results: Total P and MPQS remained stable over all nonvegan plant-based scenarios, but showed a large decrease in the vegan scenario. Conclusions: shifting to a fully vegan diet severely compromises total protein intake and protein quality in older adults, whereas shifting to a vegetarian or flexitarian diet does not.

Keywords: protein quality; plant-based nutrition; older adults

Author Contributions: P.G. presented the abstract; P.G. and J.B. wrote the abstract and analysed the data; M.D.v.d.S., J.L., A.R., I.T., M.T. and W.R. collaborated in the project and were involved in funding acquisition. All authors have read and agreed to the published version of the manuscript.

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The Role of Ultra-Processed Foods in Plant-Based Diets: Associations with Human Health and Environmental Sustainability [†]

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Abstract: Background: The growing consumption of ultra-processed foods (UPFs) among vegetarians and vegans may occur at the expense of the health and environmental benefits of plant-based diets. Objectives: This study aimed to investigate the associations of UPFs in plant-based diets with all-cause mortality and environmental impact. Methods: Analyses were based on 35,030 participants

(20–70 years; 74% females) from the EPIC-NL cohort who were followed up from 1993 to 1997 through 2014. The Plant-Based Diet Index (PDI) and UPF consumption (g/2000 kcal) were calculated using a validated FFQ. Based on a median split of the PDI and UPF consumption, four dietary categories were created (e.g., high PDI score/low UPF consumption). Cox proportional hazard and multiple linear regression models were used to estimate associations with all-cause mortality risk, greenhouse gas (GHG) emissions, and blue water consumption. Results: Among diets high in plant-based foods, higher UPF consumption tended to be associated with a 5% (HR: 1.05, CI: 0.95, 1.16) increased all-cause mortality risk and was statistically significantly associated with 1.3% (95% CI: 0.7, 1.9) higher GHG emissions and a 2.5% (95% CI: −3.1, −1.3) lower blue water consumption compared to lower

UPF consumption. Diets lower in plant-based foods were associated with a 15% (HR: 1.15, CI: 1.05, 1.26) and 24% (HR: 1.24, CI: 1.13, 1.36) increased mortality risk, 11.7% (95% CI: 11.4, 12.3) and 12.5% (95% CI: 11.9, 13.0) higher GHG emissions, and 8.8% (95% CI: −9.4, −8.2) and 11.3% (95% CI: −12.6, −10.7) lower blue water consumption for low and high UPF consumers, respectively, compared with diets high in plant-based foods and low in UPF. Discussion: UPF consumption did not counteract the health and (reduced) environmental impacts of adhering to a more plant-based diet, although special concern needs to be given to the high blue water consumption of specific plant foods. Future research should clarify whether this also holds for current settings in which populations consume higher amounts and different types of (plant-based) UPFs.

Keywords: plant-based diet; ultra-processed foods; NOVA classification; all-cause mortality; environmental impact; cohort study

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Acceptance of Alternative Meats in a Multiethnic Asian Cohort: A Comparison of Plant-Based Meat Alternatives, Cultured Meat, and Insect-Based Products [†]

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and Mary F.-F. Chong ^{1,*}



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Abstract: Background: Research on the consumer acceptance of alternative meats will aid our understanding of how to increase their consumption and demand. There are limited data on this in the Asian context, particularly comparing various alternative meat products within a singular study. Objective: In a multi-ethnic Asian population, the demographics and attitudes of individuals towards consuming plant-based meat alternatives, cultured meat, and insect-based products were examined. Methods: Adult Singapore residents ($n = 1224$) were recruited from the Multi-Ethnic Cohort Phase 2 study to participate in an online survey. Demographic information, dietary habits, and attitudes towards livestock products and alternative meats were obtained. Key demographic and attitudinal factors of consumption intent and participants' willingness to pay were identified using hierarchical ordinal regression. Results: Consumption intent for plant-based meat alternatives was the highest, followed by cultured meat, and then insect-based products. The strongest barrier to consumption intent was the perception of un-naturalness, found mostly towards cultured meat, followed by insect-based products, and then plant-based meat. Familiarity with the products and being male were associated with greater willingness to consume all three types of alternative meats. Attitudinal factors such as environmental sustainability, distrust in biotechnology, food neophobia, and animal welfare influenced the consumption intent of plant-based meat, cultured meat, and insect-based products, respectively. Participants were more willing to pay a higher price for alternative meats if they were concerned about the use of chemicals in animal products. Conclusion: Common and unique factors towards consuming the various alternative meats were identified. Our findings suggest that different communication strategies may be needed to promote the consumption and acceptance of different types of alternative meats.

Keywords: attitude; protein alternatives; clean meat

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Local Retail Food Environment Exposure and Diet Quality in Rural and Urban Adults: A Longitudinal Analysis of the ORISCAV-LUX Study [†]

Marion Tharrey ^{1,2,*} , Torsten Bohn ² , Olivier Klein ¹, Laurent Malisoux ² and Camille Perchoux ¹



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Abstract: Background and objectives: Increasing evidence suggests that complex measures of exposure accounting for the relative presence of healthy and unhealthy food outlets are more strongly associated with dietary pattern than absolute measures of the food environment, although evidence is limited by the cross-sectional design of existing studies. This study examined the long-term associations between absolute and relative measures of neighbourhood food environment and diet quality in Luxembourg. Methods: We used data of 566 adults participating in both waves of the population-based ORISCAV-LUX study (Wave 1: 2007–2009, Wave 2: 2016–2017). Diet quality was estimated in both waves using the Diet Quality Index-International (DQI-I), assessed with a 174-item food frequency questionnaire. Exposure to healthy and less healthy food outlets was computed within a 1000 m street network buffer around the participants' home address using both absolute (density, spatial access) and relative (proportion) GIS-based measurements. We used linear mixed models adjusted on individual-level covariates and neighbourhood socioeconomic status to estimate associations between cumulative exposure and change in local retail food environment and DQI-I, and tested modification by neighbourhood socioeconomic status. Results: There was a significant decrease in DQI over 10 years from 62.4 to 60.9 ($p < 0.0001$). Less healthy food outlets increased by +56% over the 10-year. The results showed a 56% increase in less-healthy food outlets over the period. In an adjusted mixed-effects linear regression, high (vs. low) cumulative exposure to less-healthy food outlets is associated with lower DQI-I, when examining spatial access ($\beta = -1.25$, 95% CI: $-2.29, -0.22$) and proportions ($\beta = -1.24$, 95% CI: $-2.15, -0.33$). Stratification shows these associations to be significant only among urban residents. There was no association between change in exposure to less-healthy food outlets and DQI-I. Among rural residents, increased exposure to healthy food outlets over time was associated with worsened DQI-I when examining absolute measurements (density and spatial access). This unexpected result brings into question the ability of absolute measurements to fully capture the healthiness of food environments. Neighborhood socioeconomic status did not moderate the above associations. Discussion: Our results suggest that the relative contribution of unhealthy food outlets in the neighbourhood may play a role in the deterioration of the quality of the population's diet over time, and should be given special attention by public authorities.

Keywords: foodscape; dietary indices; longitudinal; geographic information system; neighborhood effect

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author, M.T, upon reasonable request.

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Do Promotions of Healthier and More Sustainable Foods Increase Sales? Findings from Three Natural Experiments in UK Supermarkets [†]

Madison Luick ¹, Lauren Bandy ¹, Carmen Piernas ^{1,2,*}, Susan A. Jebb ¹ and Rachel Pechey ¹



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Dietary changes are necessary to improve population health and meet environmental sustainability targets. The present study aimed to analyse the impact of in-store promotional activities implemented in major UK supermarkets on purchases of healthier and more sustainable foods. Methods: Three natural experiments examined the impact of promotional activities on (a) no-added-sugar (NAS) plant-based milk (in 200 stores over 3 weeks), (b) products targeted during a ‘Veganuary’ event (in 96 stores over 4 weeks), and (c) seasonal fruit (in 100 non-randomised intervention and 100 matched control stores over 16 weeks). Data were provided on store-level product sales, in units sold and monetary value (GBP), aggregated weekly. The predominant socioeconomic position (SEP) of the store population was provided by the retailer. The primary analyses used interrupted time series and multivariable hierarchical mixed-effects models. Results: Sales of both promotion-targeted and overall NAS plant-based milks during the promotional period increased (targeted food: +126 units, 95% CI: 105, 148; overall: +307 units, 95% CI: 264, 349). The increase was greater in stores with predominately low SEP shoppers. During Veganuary, sales increased for plant-based foods on promotion (+60 units, 95% CI: 37, 84), but not for the sales of plant-based foods overall (dairy alternatives: −1131 units, 95% CI: −5821, 3559; meat alternatives: 1403 units, 95% CI: −749, 3554). There was no evidence of a change in the weekly sales of promoted seasonal fruit products (assessed via ratio change in units sold: 0.01, 95% CI: 0.00–0.01), and overall fruit category sales slightly decreased in intervention stores relative to the control (ratio change in units sold: −0.01, 95% CI: −0.01, −0.00). None of the promotional activities resulted in the continued purchase of promoted products after the intervention period was over. Conclusion: Promotional activity (including prominent positioning and price promotions) related to healthier or more sustainable food products can have a short-term impact on what food consumers purchase. But interventions are short-lived and effects on behaviour are not sustained, suggesting these have limited value in the long-term goal to achieve healthier and more sustainable purchasing patterns. Keywords: sustainable diet; promotions; supermarkets; purchases

Keywords: supermarket; promotions; food

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Author Contributions: Conceptualization, L.B., R.P., C.P. and S.A.J.; methodology, L.B. and M.L.; formal analysis, M.L.; writing—original draft preparation, M.L.; writing—review and editing, L.B., R.P., C.P. and S.A.J.; funding acquisition, S.A.J. All authors have read and agreed to the published version of the manuscript.

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The European Health Map: A Comparative Literature and Policy Analysis of the Definition of Health in Europe to Realize Healthy and Sustainable Diets [†]

Billy van Zoomeren * , Pieter van 't Veer and Anneleen Kuijsten



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Abstract: *Background and Objectives:* In the current era of

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overshooting both planetary boundaries and social limits, the question arises as to whether the 1948 definition of health (DoH) from the WHO is fit for purpose. As healthy and sustainable diets (HSDs) are among the key societal and planetary challenges in the 21st century, this report focused on the DoH in European policy aimed at realizing HSDs. *Methods:* The viability of the European DoH of eight European high-income countries was evaluated in a comparative mixed-methods approach, combining a literature review with qualitative and quantitative policy analyses. In addition, national policy documents were analysed in order to define national DoHs and get insight into their operationalizations. To evaluate policies on HSDs, sustainability was uniquely conceptualised as being interrelated to human health, planetary health, and the food system. *Results:* The operationalizations of the European and national DoHs appear to not be in line with the 1948 WHO DoH. Vastly holistic definitions of sustainability as described in scientific literature are currently absent in European policy, and science-policy gaps are found at several levels. In the DoHs, we identified an anthropocentric bias, with economic growth as the ultimate goal of health policies. HSDs appear to be promoted primarily to address these policy goals, instead of being a health goal on their own. This unravels the lack of intrinsic value of sustainability in European health and sustainability policy. Moreover, the potential of the food system to simultaneously benefit human and planetary health is not acknowledged in national health policies. *Discussion:* In conclusion, the current European DoH appears to not be viable to face 21st century challenges. In order to improve this, the food systems perspective in policy can be used as the unifying concept for both human and planetary health. European policy could benefit from the implementation of a focus on resilience, combined with acknowledging the interrelations between human health, planetary health, and the food system in the eye of sustainability. The insights provided in this report can be used for effective policy-making to improve health, food systems thinking, and as policy guidance towards the realization of HSDs, especially in the European context.

Keywords: definition of health; European policy; healthy and sustainable diets; food system; health policy; sustainability; anthropocentrism

Author Contributions: Methodology, formal analysis, investigation, resources, writing—original draft preparation, visualization: B.v.Z.; Conceptualization, writing—review and editing, B.v.Z., P.v.'t.V. and A.K.; supervision, P.v.'t.V. and A.K. All authors have read and agreed to the published version of the manuscript.

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Can Plant-Based Diets Facilitate Dietary Transition in Bolivia?: An Exploratory Study [†]

Federico J. A. Perez-Cueto ^{1,*} , Rosaluz Valda-Romero ² , Jean-Paul C. Garin ¹ and Inês Magalhães ³



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Abstract: Background and objectives: Bolivia has experienced increased meat production and consumption in the past years, particularly due to importance of an emerging market, namely China, and a strong culinary tradition in which meat is the centrepiece of the meals. Bolivian animal protein production system is one of the most inefficient methods used worldwide from an environmental perspective. As climate change accelerates, it is important to identify potential drivers of a dietary shift towards more sustainable foods in countries like Bolivia, which are already facing the consequences of the climate-related disruptions in the food chain and will be further affected in the coming years. A dietary shift toward more plant-based diets seems to be the most sensible societal change to empower individuals to act in response to climate change. Our objective is to explore the effects of intention on dietary shift, as well as attitudes towards social, economic, and environmental sustainability on the perception that plant-based foods facilitate a sustainable healthy dietary transition. Methods: We conducted a cross-sectional study, using online questionnaire filled in by a sample of voluntary respondents. Attitudinal data were obtained via seven-point Likert scales. Linear regression in agreement with the statement “plant-based foods facilitate a sustainable healthy dietary transition” was the dependent variable (mean 5.2 ± 1.7), and the attitudes towards social, economic, and environmental sustainability and intention to undergo a dietary shift were the independent variables; we controlled for sex and age. Data were analysed using SPSS v.28, and a p -value < 0.005 was considered significant. Results: In total, 303 people filled in the questionnaire, of whom 62 did not give consent to use their data, 18 provided straight line answers, and 90 provided inconsistent answers with regard to controlling variables. Therefore, 132 respondents’ responses were used, of whom 59% were women, with an average age of 25 y (± 13), and 93% lived in the city of Cochabamba. After controlling for sex and age, significant positive associations were found for the intention to change their current diet and the statement that policies should promote social equity and progressive taxation, while a negative association was found with regard to the perception that policies should prioritise the wellbeing of people and the planet above those of the industry. Conclusion: the perception that plant-based diets can facilitate sustainable healthy dietary transitions in Bolivia mainly depended on how sustainability aspects were assessed by the respondents.

Keywords: attitudes; Bolivia; diet transition; plant-based diet

Author Contributions: Conceptualization, F.J.A.P.-C. and R.V.-R.; methodology, All authors; software, J.-P.C.G. and I.M.; validation, J.-P.C.G. and I.M.; formal analysis, F.J.A.P.-C., J.-P.C.G. and I.M.; investigation, J.-P.C.G. and I.M.; resources, F.J.A.P.-C. data curation, J.-P.C.G., F.J.A.P.-C., and I.M.; writing—original draft preparation, F.J.A.P.-C.; writing—review and editing, F.J.A.P.-C.; supervision,

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Nutritional Composition of Ultra-Processed Plant-Based Foods in the Out-of-Home Setting: A Case-Study with Vegan Burgers [†]

Reina E. Vellinga ^{1,*} , Elisabeth H. M. Temme ¹ , Holly Ripplin ², Carla Motta ³ , Gerard Bryan Gonzales ⁴ , Clare Farrand ² and Kremlin Wickramasinghe ²



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Abstract: Introduction: Ultra-processed plant-based foods, such as plant-based burgers, have gained popularity and are perceived by consumers as a healthier and more environmentally sustainable alternative to animal-based foods. However, evidence regarding their nutritional profile and environmental sustainability is still evolving. Purpose: To contribute to the understanding of the nutrient profile of ultra-processed plant-based foods in the out-of-home environment. Methods: Cities in four WHO European Member States were selected for study in a convenience sample across the regions of Amsterdam, Copenhagen, Lisbon, and London. Plant-based burgers available at selected out-of-home sites were randomly sampled. In total 41 plant-based burgers were lab-analyzed for their energy, macronutrients, amino-acids and minerals content per 100 g and per serving size. Descriptive data were used to summarize the nutritional composition per 100 g and serving size. The content per serving was compared to the appropriate reference values. Results: The median energy content was 234 kcal/100 g (IQR = 50). Median macronutrient composition was 20.8 g/100 g (IQR = 5.7) carbohydrates and 3.5 g/100 g (IQR = 1.8) dietary fibre. Protein content was 8.9 g/100 g (IQR = 3.7) with low protein quality. The median total fat content was 12.0 g/100 g (IQR = 4.2), including 0.08 g (IQR = 0.05) TFA and 2.2 g (IQR = 2.3) SFA. The median sodium content was 389 mg/100 g (IQR = 113), equivalent to 2.7 g salt. When compared with reference values, the median serving of plant-based burgers (280 g) provided 31% of energy intake and contributed 17–28% of carbohydrates, 42% of dietary fibre, 40% of protein, and 48% of total fat including 26% of SFA. The burgers had low-quality protein. One serving provided 15–20% of the reference values for calcium, potassium, and magnesium, while higher contributions were found for zinc (30%), manganese (38%), phosphorus (51%), and iron (67%). Conclusion: Ultra-processed plant-based foods, such as plant-based burgers, provide protein, dietary fibre, and essential minerals. They also contain high levels of energy, sodium, and fatty acids. Despite their potential as a source of protein, the quality of protein in plant-based burgers is low. The multifaceted nutritional profile of plant-based burgers highlights the need for manufacturers to implement improvements to better support healthy dietary habits. These improvements should include reducing salt and fatty acids while also enhancing protein quality.

Keywords: plant-based burgers; plant-based-foods; ultra-processed-foods; reference intakes

Author Contributions: Conceptualization: C.M., G.B.G., H.R., R.E.V., E.H.M.T.; Project management: H.R.; Investigation: R.E.V.; Lab-analyses: C.M.; Data analysis: R.E.V.; Writing—original draft: R.E.V.; Writing—review & editing: R.E.V., H.R., G.B.G., E.H.M.T., C.F., C.M., K.W. All authors have read and agreed to the published version of the manuscript.

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Investigating the Potential of Nutri-Score to Discriminate between Environmental Impact of Foods [†]

Elly Steenbergen * , Reina E. Vellinga and Elisabeth H. M. Temme



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Abstract: Background: There is a need for uniform communication on healthy and sustainable food choices.

Several front-of-pack labels exist with the purpose of informing consumers. Nutri-Score has been introduced in Europe, aiming to help the public make more nutritionally sound choices. However, its potential to also aid consumers in making environmentally sustainable food choices has not yet been studied. Objective: to determine the extent to which the Nutri-Score algorithm is capable of discriminating foods based on their environmental impact. Methods: Nutri-Scores were calculated for foods in the Dutch food composition database. The environmental impact was assessed using lifecycle assessments. Correlations between Nutri-Scores and environmental impact indicators (greenhouse gas (GHG) emission, land use, water consumption, fresh and marine-water eutrophication, and acidification) were assessed. Correlation estimates were obtained for the main food groups. Results: Final Nutri-Scores (FNSs) and environmental impacts were calculated for

1853 foods, with FNSs ranging from −15 to −1 (most favorable) and 19 to 40 (least favorable). The FNSs for “Meat and poultry”, “Cold cut meats”, and “Fish” showed inverse correlations with environmental impacts ($r = -0.07$ to -0.36), whereas FNSs for “Cheese” and “Dairy” showed positive correlations ($r = 0.24$ to 0.59). The FNSs for “Fats and oils”, “Bread”, and “Fruit” had the highest correlations. The FNS for “Fats and oils” showed moderate correlations with GHG emissions ($r = 0.66$), marine-water eutrophication ($r = 0.59$), and acidification ($r = 0.50$). The FNS for “Bread” showed moderate correlations with land use ($r = 0.62$), freshwater eutrophication ($r = 0.58$), marinewater eutrophication ($r = 0.58$), and acidification ($r = 0.52$). Similarly, the FNS for “Fruit” showed moderate correlations with acidification ($r = 0.72$), marine-water eutrophication ($r = 0.55$), and land use ($r = 0.52$). Conclusion: For Meat and poultry, Cold cut meats and Fish, a higher FNS, indicating a less healthy food choice, correlated with lower environmental impacts. On the contrary, especially for the food groups Cheese, Dairy, Fruits, Bread, and Fats and oils, a higher FNS, indicating a healthier food choice, was correlated with higher environmental impacts. Therefore, depending on the food group, healthier food choices according to the Nutri-Score can potentially guide consumers toward more environmentally sustainable food choices. Though trade-offs exist, the use of Nutri-Score may be beneficial for both human and planetary health.

Keywords: nutri-score; eco-score; planetary health; environmental impact

Author Contributions: Conceptualization, E.S., R.E.V. and E.H.M.T.; methodology, E.S. and R.E.V.; software, E.S.; formal analysis, E.S.; investigation, E.S. and R.E.V.; writing—original draft preparation, E.S. and R.E.V.; writing—review and editing, R.E.V. and E.H.M.T.; visualization, E.S.; supervision, E.H.M.T. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Publicly available datasets were analyzed in this study. This data can be found here: <https://nevo-online.rivm.nl/Home/En> and <https://www.rivm.nl/voedsel-voeding/duurzaam-voedsel/database-milieubelasting-voedingsmiddelen>.

Conflicts of Interest: E.S. is member of the international Technical Committee of Nutri-Score. E.H.M.T is member of the international Scientific Committee of Nutri-Score.

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Validity of REFRESH, a New Screener for Assessing Environmentally Sustainable and Healthy Diets [†]

Ujué Fresán ^{1,*}, Anna Boronat ², Giannoula Mitsia ³, Maira Bes-Rastrollo ⁴, Itziar Zazpe ⁴,

Rafael De la Torre ² and Guillaume Chevance ¹



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Current dietary patterns are the leading cause of morbidity and mortality worldwide, in addition to significantly contributing to natural resource scarcity, environmental degradation, and biodiversity loss. The general adoption of healthy diets with a low environmental impact is timely. While dietary screeners have been used widely to assess the nutritional adequacy of diets, no simple tool that considers both human and environmental dimensions has been developed. Methods: We developed REFRESH (Rapid Evaluation FoR an Environmentally Sustainable and Healthy diet), a 10-item screener that briefly assesses the dietary environmental sustainability and healthiness at once by evaluating habitual consumption of key food groups for a healthy and environmentally sustainable diet. The scoring criteria are based on the EAT-Lancet Commission, FAO, and WHO recommendations. Overall, REFRESH score ranges from 0 to 10 points, with

0 being the lowest and 10 being the highest for adopting an environmentally sustainable healthy diet. Subsequently, we conducted a validation study to evaluate the reliability and validity of REFRESH. In this study, 100 participants were asked to complete the screener's questionnaire. The results were then compared with a 7-day food record completed in the following week. The questionnaire's reliability was evaluated by comparing reported servings in both dietary assessments. Additionally, we evaluated the capacity of REFRESH's scoring system to capture dietary quality and environmental impact. Results: Preliminary validation study results indicated a mean REFRESH score of 5.73 points (range: 1–8) among the participants. Comparing the REFRESH data to the food records, we found a good correlation among both dietary tools. However, we identified that participants tended to slightly overestimate their consumption of legumes, fruits, and vegetables while underestimating their consumption of highly processed foods. The diet of participants who scored higher included a larger proportion of whole plant-based foods. This pattern led to a higher intake of fiber, a lower intake of saturated fats, and a 20% lower environmental impact. Discussion: REFRESH is a valid instrument for rapid estimation of healthy and environmentally sustainable diets and, thus, can be useful for research and clinical practice. The availability of such a validated screener is crucial for promoting environmentally sustainable healthy dietary changes in the general population.

Keywords: sustainable diet; life cycle assessment; dietary screener; dietary environmental impact; plant-based diet; planetary diet

Author Contributions: Conceptualization, U.F., A.B. and G.C.; methodology, U.F., A.B. and G.C.; software, U.F., G.M. and A.B.; formal analysis, U.F.; investigation U.F. and A.B. resources, M.B.-R. and I.Z.; writing—original draft preparation, U.F. and A.B.; writing—review and editing, U.F., A.B., G.M., M.B.-R., I.Z., R.D.I.T. and G.C. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Comité de Ética de la Investigación con medicamentos del Parc de Salut Mar (observational study number 2023/10861) on Barcelona, 10 May 2023.

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Landscape of Nutrition- or Diet-Related Randomised Controlled Trials: Data from Protocols Published between 2012 and 2022 [†]

Michael Schlüssel ^{1,*}, Flavia Moraes ², Simone Bernardes ²  and Solange Durão ³



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Citation: Schlüssel, M.; Moraes, F.; Bernardes, S.; Durão, S. Landscape of Nutrition- or Diet-Related Randomised Controlled Trials: Data from Protocols Published between 2012 and 2022. *Proceedings* **2023**, *91*, 427. <https://doi.org/10.3390/proceedings2023091427>

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Abstract: Background and aims: As part of a project to consolidate reporting guidance for randomised controlled trials (RCTs), protocols of RCTs, and systematic reviews of nutritional interventions, it was important to understand the nutritional interventions research landscape over the past decade. We aimed to assess the nutrition or diet-related interventions research landscape using data from RCT protocols published as research articles between 2012 and 2022. Methods: We searched six databases for eligible protocols published between January 2012 and March 2022. Data extracted included bibliometrics, study scope (population, intervention, comparator, outcome, study design), and research transparency practices (protocol registrations, conflicts of interest and funding statements, mentions of reporting guidelines). We screened the “Instructions for Authors” webpages of each journal contributing publications to our sample to check whether they endorsed reporting guidelines. Results: We included 1068 protocols. The frequency of publication of RCT protocols as research articles increased annually, with a mean of 161 (range: 155 to 163) publications/year. Healthy (n = 342; 32.0%) adults and elderly people (n = 350; 32.7%) composed the most frequent target population. Isolated nutrition- or diet-related interventions (n = 724; 67.8%) were most frequently studied, with supplementation (n = 405; 37.9%) being the most common type of intervention. The most frequent primary outcome reported was clinical status (n = 308; 28.8%). Most protocols described a singlecentre (n = 838; 78.5%), two-arm (n = 844; 79.1%), parallel (n = 1014; 94.9%) RCT. Of the 148 journals in which the included protocols were published, general medical journals (n = 518; 48.5%) contributed more publications compared to methods journals (n = 479; 44.9%) and nutrition journals (n = 71; 6.6%). The SPIRIT statement was endorsed by 33.8% (n = 50) of the journals, CONSORT by 75.3% (n = 111), and TIDieR by 2.7% (n = 4). In 32.1%, 27.8%, and 1.9% of publications, the authors mentioned SPIRIT, CONSORT, and TIDieR, respectively. Most protocols (n = 1006; 94.2%) reported the study registration and included conflicts of interest (n = 952; 89.1%) or funding (n = 994; 93.2%) statements. Conclusions: The number of nutrition- or diet-related RCT protocols being published as research articles is increasing over time, showing the importance of this type of publication. The adoption of research transparency practices by researchers and journals can still improve.

Keywords: nutritional interventions; randomised controlled trials; protocols

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The Impact of the Universal Infant Free School Meals Policy on the Ultra-Processed Food Content of Children's Lunchtime Intake in England and Scotland [†]

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Abstract: Background: A universal infant free school meals (UIFSM) policy was introduced in 2014/15 in England and Scotland for schoolchildren aged 4–7 years; as a result, school meal uptake rose sharply. School food in the UK is known overall to be healthier and less processed than food brought from home (packed lunches), but it is unknown as to how UIFSM impacted the level and type of ultra-processed food (UPF) consumed. Therefore, this study aimed to evaluate the impact of the UIFSM policy on the processing levels of food consumed during the school lunchtime period among schoolchildren in England and Scotland. Methods: Data from the National Diet and Nutrition Study (NDNS), a nationally representative repeated cross-sectional survey, were used to conduct a difference-in-difference study. The average intake of UPF (% of total lunch grams and % total lunch Kcal) using the NOVA classification was calculated for each school lunch. The lunchtime intakes in the intervention group (4–7 years, n = 866) were compared to the control (8–11 years, n = 808) pre- (2008–2014) and post-intervention (2014–2019) using linear regression, adjusting for sociodemographic variables and total lunchtime intake (grams). Inverse probability weights were used to balance the characteristics across the intervention groups. Results: Before UIFSM, the consumption of UPFs as a proportion of total lunch energy (UPF % Kcal) was similar in the intervention and control groups (67% Kcal vs. 69% Kcal). After adjustment for covariates, UPF consumption decreased by 6.3 pp (95% CI –11.3, –1.3) after UIFSM. The findings were similar for UPF as the percentage of total lunch grams. These effects were driven by increases in minimally processed dairy and eggs and starchy foods and decreases in salty snacks and ultra-processed bread and drinks consumption. The greatest reduction in UPF consumption was in low-income children (–17.2% Kcal; 95% CI –26.5, –7.8), compared to mid- (0.5% Kcal; 95% CI –4.0, 1.0) or high-income children (–5.3% Kcal; 95% CI –13.6, 2.9). Conclusions: This study builds on previous evidence and shows that UIFSM improved children's dietary intake at school by minimising exposure to UPFs. These results indicate that universal free school meal policies could be an important policy for long-term equitable improvements in children's diet and subsequent health.

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Abstract

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Abstract

The Relationship between Serum Polyunsaturated Fatty Acids and Dietary Inflammatory Index in Children with Recurrent Respiratory Infections [†]

Natalia Związek ^{1,*}, Anna Prescha ¹, Daiva Gorczyca ², Mariola Paściak ³ , Bogumiła Szponar ³ 
and James R. Hebert ^{4,5}



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Abstract: Background and objectives: Respiratory tract infections are the most common cause of children's morbidity in the world. Children with recurrent respiratory tract infections (RRIs) frequently use health care services and antibiotics, undergo surgical procedures and are at risk of asthma in early life. In RRIs, the induction of the immune system and inflammatory processes is associated with changes in metabolic milieu; however, the polyunsaturated fatty acid (PUFA) blood profile in RRIs has not been well recognized. Diet is among the factors that can modulate inflammation; therefore, we aimed to investigate the effect of the inflammatory potential of diet on the serum PUFA profile in children with RRIs and on the risk of the disease. Methods: In 44 children with RRIs aged 3–16 years and 44 healthy children aged 2.5–17 years, dietary intake was assessed via 24 h dietary recall, then the children's dietary inflammatory index (C-DII) was calculated using dietary data. Serum PUFA levels were determined by gas-liquid chromatography-mass spectrometry, and immunological parameters were investigated in children with RRIs. Results: One-third of the RRI group had elevated IgE level and 14% had eosinophilia. Dietary intake did not differ in either group, except for significantly lower fiber intake in RRI children (7.97 g/1000 kcal vs. 9.43 g/1000 kcal, $p = 0.004$, respectively). The RRI group was characterized by the higher inflammatory potential of the diet than in the control group (C-DII = 0.26 vs. -0.92 , $p = 0.000$). In the serum of RRI children, a higher level of linoleic acid, arachidonic acid, and eicosapentaenoic acid was shown than in healthy subjects. The C-DII score was positively associated with serum n-6 PUFA levels in both groups. The high inflammatory potential of the diet, low fibre intake, BMI over 75 percentile, and a lack of breastfeeding or its duration up to 6 months age were identified as RRI risk factors. Discussion: Our study indicates that assessing the inflammatory potential of diet and nutritional status may be crucial for determining comprehensive interventions in RRIs, as well as for establishing rational preventive management.

Keywords: recurrent respiratory tract infections; diet; inflammation; polyunsaturated fatty acids; serum

Author Contributions: D.G. and A.P. conceived of and designed the study. M.P., B.S., J.R.H. and N.Z. compiled and prepared the study data, conducted analyses, and had full access to the data. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Study protocol, statistical analysis plan and individual participant data will be available (including data dictionaries) beginning 3 months and ending 5 years following article publication. Proposals should be directed to daiva.gorczyca@charite.de; to gain access, data requestors will need to sign a data access agreement.

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Preliminary Prevalence of Vitamin D and Iron Deficiency in Healthy Primary School Children [†]

Emily Royle ^{*}, Kirsty Pourshahidi , Emeir McSorley and Pamela Magee



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Abstract: Nutritional deficiencies in iron and vitamin

D are common in children at a global level, albeit they can be overlooked in apparently healthy children. Iron deficiency in children has been associated with a higher prevalence of vitamin D deficiency, although it is unclear which deficiency has the greater effect on the other, owing to the different metabolic fates of each nutrient. Iron is required in the second hydroxylation step in conversion of 25-hydroxyvitamin D (25[OH]D) to the active form, 1,25(OH)₂D, whereas sufficient vitamin D status may lower the risk of anaemia through a reduction of inflammation. This study examined the differences between sufficient and insufficient/deficient 25[OH]D concentrations and haemoglobin concentrations in a child cohort. Vitamin D status [plasma 25(OH)D] was determined using Liquid Chromatography Tandem Mass

Spectrometry from samples collected between November 2019–February 2023. Complete blood counts were conducted using a Sysmex automated analyser to determine the haemoglobin status. Nonanaemia was defined as haemoglobin concentrations ≥ 115 g/L (4). Anthropometric measurements were also recorded, including height (cm) and weight (kg). A Mann–Whitney U test was conducted to assess the differences in haemoglobin concentrations between vitamin D sufficient (>50 nmol/L), insufficient (25–50 nmol/L), and deficient (≤ 25 nmol/L) participants. Due to numerical constraints, deficient and insufficient children were grouped together as non-sufficient. A total of 159 children aged 4–11 years were enrolled on the study. The median (IQR) age was 8 (7) years, and 52% were female. Plasma 25(OH)D concentrations ranged between 21.31 and 141.11 nmol/L. Whole blood haemoglobin concentrations ranged between 101.0 and 158.0 g/L. Overall, 3% ($n = 5$) of children were classed as iron-deficient anaemic, 1.9% ($n = 3$) and 28.9% ($n = 46$) were vitamin D deficient and insufficient, respectively. Haemoglobin concentrations in vitamin D sufficient (median 130.0 g/L) and non-sufficient children (median = 128.5 g/L) were not statistically different ($U = 2685$, $z = 2685$, $p = 0.970$). These preliminary results suggest that vitamin D and haemoglobin concentrations were predominantly sufficient in this cohort of children. Close to one third of participants had an inadequate vitamin D status, and thus this may explain why no differences in haemoglobin concentrations were observed according to vitamin D status.

Keywords: vitamin D; children; iron; insufficiency; haemoglobin

Author Contributions: Conceptualization, P.M., E.M. and K.P.; methodology, P.M., E.M. and K.P.; formal analysis, E.R.; performed the statistical analysis, E.R.; investigation, E.R., P.M., E.M. and K.P.; data curation, E.R.; writing—original draft preparation, E.R.; writing—review and editing, E.R., P.M., E.M. and K.P.; supervision, P.M., E.M. and K.P.; project administration, E.R. All authors have read and agreed to the published version of the manuscript.

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Sport Nutrition Knowledge among Athletes and Recreational People [†]

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Abstract: Introduction: Knowing the principles of proper nutrition is extremely important for everyone, especially for athletes, but also for recreational people. Objective: The aim of the research was to examine and compare the level of knowledge about nutrition and supplementation among athletes and recreational sports players. Participants and methods: A cross-sectional observational study was conducted on athletes from Montenegro (N = 249, 71.5% men and 28.5% women) and recreationists from Bosnia and Herzegovina (N = 156, 57.7% men and 42.3% women). A specially structured questionnaire was used to assess knowledge about nutrition and supplementation from the perspective of sports performance. Results: Supplementation is used by 60.6% of athletes and 67.3% of recreationists. Athletes use vitamins the most (75.3%), while recreationists use proteins the most, alone (30.8%) or in combination with vitamins (21.2%) and creatine (12.2%). The fact that the majority of recreationists make decisions about supplementation independently (67.9%) is worrying, while among athletes, decisions about the need for supplementation are made independently 32.7% of the time and according to the trainer's recommendation 28.6% of the time. A low level of knowledge about nutrition and supplementation was found in both groups of respondents, but athletes showed somewhat better knowledge compared to recreational players; athletes had an average of 77.2% correct answers and recreational athletes had an average of 67.7%. The fact that most athletes (30.9%) are not informed about nutrition at all and that 28.1% receive information from fitness trainers is worrying. On the other hand, recreational users primarily look for information about nutrition on the Internet (56.4%). Conclusion: The results show a devastating level of knowledge about the influence of nutrition on sports performance, especially around certain aspects (e.g., protein sources in the diet). Despite this, a majority of people independently decide to use supplements.

Keywords: sport nutrition; knowledge; athletes; recreational people



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Validation and Reproducibility of a Web-Based Dietary Assessment Tool—MyFood24—In a Danish Population: A Cross-Sectional Validation Study [†]

Sadime Basak
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Abstract: Background: The validation and reproducibility assessment of dietary assessment tools are needed in order to assess the precision and accuracy of the methods applied when estimating habitual intake. Using objective biomarkers in these validation studies is a further strength. Earlier validation studies showed high rates of underestimation of dietary energy intake. Myfood24 is an online tool that was developed in 2015 in the UK with the aim of being able to cover the need for high-quality dietary assessment instruments with a high validity and reliability for all ages, and it has already been validated in settings consisting of British and German adults, but not in a Danish population. Objective: To assess the validity and reproducibility of a self-administered 7-day web-based dietary assessment tool, Myfood24[®], among healthy Danish adults regarding objective biomarkers, and to assure the quality of a self-administered web-based dietary recall tool as a valid dietary assessment method for internal use. Methods: A cross-sectional study with repeated measurements is being conducted with healthy adults from both sexes. Participants are asked to complete a self-administered web-based 7-day 24 h dietary recall tool (Myfood24[®]) at baseline and 4 weeks after (± 1 weeks). The validity of this tool will be assessed by comparing the estimated mean dietary intake obtained by the tool with reference measures of energy metabolism and objective biomarkers of intake of selected nutrients: measurements of the concentration of urea, creatinine, and potassium analyzed in a 24 h urine sample, as well as folic acid in fasting blood plasma samples as a biomarker of intake of fruit and vegetables. The estimated dietary intake of energy will be compared with resting energy expenditure (REE) measured by means of indirect calorimetry and multiplied by a PAL value obtained from the IPAQ-International Physical Activity Questionnaire. Reproducibility will be assessed by means of comparison of the results of two 7-day web-based dietary assessments obtained by Myfood24[®], 4 weeks apart. Preliminary results: Among 164 interested subjects, a total of 67 were eligible according to the inclusion and exclusion criteria. At the time of writing, 35 subjects (9M/26 F) have completed the first visit of the study, while 97 subjects have been excluded. Of the included subjects, 24 have finished the second dietary recording and finished their participation after a final meeting with a dietician. The trial will end in September 2023. The baseline characteristics (mean \pm SD) are as follows: age, 55.2 \pm 10 years; height, 1.69 \pm 0.09 m; body weight, 74.4 \pm 10.6 kg; and BMI, 25.8 \pm 2.4. REE was 1427 \pm 201 kcal. Discussion: The recruitment is still ongoing. More results will be ready to be presented at the FENS conference.

Keywords: validation; dietary assessment; Myfood24; reproducibility



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Single-Center Observational Study of Impact of Regular Consumption of Fish Oil Supplements Alongside Weight Loss Medicines on Metabolic Profile of Patients with Metabolic Syndrome [†]

Ashwinkumar Dabhi ^{1,*} and Leena Ashwin Dabhi ²



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Citation: Dabhi, A.; Dabhi, L.A. Single-Center Observational Study of Impact of Regular Consumption of Fish Oil Supplements Alongside Weight Loss Medicines on Metabolic Profile of Patients with Metabolic Syndrome. *Proceedings* **2023**, *91*, 383. <https://doi.org/10.3390/proceedings2023091383>

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Abstract: The prevalence of MS has increased exponentially in the last two decades, and more so after the COVID-19 pandemic, alongside numerous weight loss interventions with both favorable and adverse health outcomes. India is a capital of patients with metabolic syndrome occurring at quite a young age due to altered body composition with inflammations going on backstage. Various studies have already documented low to very low consumption of Omega-3 FA across many parts of the world, including India, and to overcome this, we designed a strategy to supplement Omega-3 FA alongside a standard of care and medical and lifestyle interventions for MS. In this study, all patients were given a mixed EPA/DHA 1 gm Omega-3 FA capsule within 2 h of the completion of meals three times a day, all through the study duration of 6 months. There were significant reductions in metabolic profiles, including lipid profiles, hs CRP, hepatic transaminases, and glycemic parameters, across a wide range of metabolic derangements. Among patients with dyslipidemia, there were significant reductions in triglycerides and borderline elevations in HDL. In diabetic and prediabetic patients, there were significant reductions in FBS, PPBS, and glycemic parameters like HBA1C. Many participants with prediabetes and diabetes had improvements in fibromyalgia, lethargy, and lassitude. To conclude, there is a potential for optimizing the use of Omega-3 FA in countries with low to very low consumption of fatty fish, and due to its multimodal actions and safety profile, it is assumed that the majority of patients will need such supplements to improve their metabolic profiles.

Keywords: MS; EPA/DHA

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Abstract

Assessing Prevention Priorities in French Family Caregivers of the Elderly at Risk of Loss of Autonomy: Results from a Community Intervention on Diet [†]

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Abstract: Background and objectives: Population aging increases losses of autonomy, leading to 4.3 million French caregivers for elderly relatives in 2015. This challenging role can lead caregivers to neglect their own health, e.g., one in three carers die before their supported person. There are a lack of data on understanding health conditions and determinant factors in caregivers. The first phase of the 3-year community intervention project “AlimAidants” aimed to conduct a needs analysis to identify prevention priorities related to diet in family caregivers in the Oise region, France. Methods: The in-depth needs analysis collected information in seven categories, e.g., sociodemographic data of the caregiver and supported person, the support provided, impacts on health status and lifestyle, dietary behavior and consumption, and preferences for intervention types. A semi-quantitative self-administered questionnaire was disseminated in paper or digital formats to caregivers through a comprehensive regional network of professionals, associations, and social centers (n = 99) between February and June 2022. Data were analyzed using descriptive statistics and hierarchical cluster analysis with SPSS 28. Results: The response rate was 38,4% (n = 38). Caregivers were mostly women (71%) and were, on average, 59.7 (±12.6) years old. Briefly, 66% provided daily support, performing an average of 4.7 different tasks which impact multiple mental health parameters (61% perceived stress and anxiety, 58% perceived mental fatigue, and 55% perceived physical fatigue). A total of 63% were responsible for relatives’ groceries and 56% were responsible for meal preparation. A total of 84% of caregivers were interested in prevention actions related to diet, e.g., preventing malnutrition (58%) or quick meals (71%). No difference in snacking behavior was determined. Three distinct profiles of caregivers were identified: young carers who balance their role with their personal life, retired and overburdened but highly motivated caregivers, and retired isolated caregivers whose mental health is severely impacted. The preferred formats varied according to the caregiver’s professional situation: digital and offline sessions for the employed and face-to-face workshops for retirees. Discussion: The results show the diversity in health conditions and determinant factors of caregivers, particularly regarding mental health status. This implies a need for personalized prevention actions related to diet which are flexible in format and time, e.g., participative workshops, webinars, videos on social networks, and conferences.

Keywords: caregivers; prevention; community intervention; diet; loss of autonomy

Author Contributions: Conceptualization, C.D., A.-K.I. and J.T.B.; methodology, C.D., A.-K.I., J.T.B. and A.T.; software, C.D.-O. and C.-N.N.; validation, A.-K.I. and C.D.-O.; formal analysis, C.D.-O. and

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Knowledge of Athletes about Proper Hydration [†]

Ivana Joksimovic *, Snezana Bajraktarovic Labovic, Dijana Djurovic, Zorica Djordjevic, Enisa Kujundzic, Magdalena Vujovic and Marina Stamatovic



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Abstract: Background and objectives: Water makes up 50 to 70% of the human body. All cellular processes take place in water. Water is lost from the body through urination, digestion, sweating, breathing and tears. Along with water, sweat also contains a significant amount of sodium, potassium, a small amount of magnesium and chloride. It is extremely important to replace everything that is lost: water, minerals (electrolytes) and vitamins. The main goal of this research is to examine the level of knowledge of athletes about proper hydration. Method: A total of 249 respondents in five Montenegrin cities participated in this research. The first part of the questionnaire that was used in this research referred to the type of sport that they practice and the level of competition, as well as the place that they come from. For the purposes of this research, anthropometric measurements and BMI, as well as determination of body composition, including total water content, were performed. Results and discussion: Of the 249 respondents, 71.5% were male and 28.5% were female. When it comes to water intake, the largest number of athletes drink seven or more glasses of water during the day (56.6%), 26.5% drink five to six glasses of water, 12.9% drink three to four glasses of water, while 4.0% drink one to two glasses of water. This research shows that athletes do not drink enough water during the day. The second group of questions was related to athletes' knowledge about fluid intake, during or after the training process, as well as during a sports competition. Here, the athletes showed a higher level of knowledge. The average level of knowledge was 43.80 ± 22.96 . A total of 43.0% know that thirst is not an adequate indicator of the need for water during training. A total of 82.7% know that fluids must be consumed before, during and after physical activity, which indicates that the behavior is not in accordance with the knowledge of the respondents. Regardless of the fact that the athletes included in our research showed a higher level of knowledge in the answers to questions related to knowledge about fluid intake, they do not drink enough water during the day.

Keywords: athletes; water; hydration; sweat; thirst

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The Relationship between Mushroom Intake and Cognitive Performance: An Epidemiological Study in the European Investigation of Cancer Norfolk Cohort (EPIC-Norfolk) [†]

Sara Cha, Lynne Bell and Claire M. Williams * 



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Abstract: Background and Objectives: Ageing is often associated with a decline in cognitive function. Nutrients from plant-based sources such as vegetables have previously been shown to benefit brain health. Only a few studies have investigated the impact of mushrooms on cognitive performance. The European Prospective Investigation of Cancer (EPIC-Norfolk) cohort provides information on habitual diet, including mushroom consumption, alongside cognitive scores. The purpose of this study was to track mushroom intake in this cohort across an 18-year period (EPIC checkpoints 1HC, 2HC, and 3HC), and investigate the relationship between mushroom intake and cognitive performance at 3HC. Methods: A total of 8623 participants (mean age: 69 years) were enrolled in the cohort. Mushroom intake was measured via food frequency questionnaire and participants were categorised into groups according to their mushroom consumption frequency. Cognitive performance was examined using a battery of validated tests (EPIC-COG), assessing several sub-domains of memory and executive function, plus a calculated global composite score. Analysis of variance (ANOVA) was used to investigate changes in mushroom intake across the three checkpoints. To investigate the relationship between mushroom intake and cognitive performance at 3HC, multivariate analysis (MANOVA) was used, treating each EPIC-COG test as a dependent variable. Finally, unadjusted and adjusted regression models were constructed to examine the relationship between global cognitive scores and mushroom intake. Results: Complete mushroom intake data (across all three checkpoints) was available for 5100 participants. A significant decrease in mushroom intake was found between 1HC and 3HC in this sample. A total of 5421 participants provided mushroom intake and EPIC-COG scores at 3HC. Multivariate analysis of this sample showed that participants consuming >1 portion mushroom/week performed significantly better in memory-based tasks compared to participants with lower/no intake. All regression models revealed higher mushroom intake to be predictive of higher global cognitive scores. Conclusion: The findings from this study suggest that regular mushroom consumption may be beneficial to cognitive health during aging. It is recommended that the potential benefits of this important food group be highlighted in public health campaigns with a view to increasing consumption rates in older-adult populations.

Keywords: epidemiological; older adults; mushroom intake; cognitive performance; memory

Author Contributions: Conceptualization, S.C., L.B. and C.M.W.; methodology, L.B., S.C. and C.M.W.; formal analysis, L.B. and S.C.; writing—original draft preparation, L.B. and S.C.; writing—review and editing, L.B. and C.M.W. All authors have read and agreed to the published version of the manuscript.

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High Adherence to Mediterranean Diet and Fish Intake Are Inversely Associated with Depressive Symptoms in Older Women: Findings from the Cross-Sectional NutBrain Study [†]

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Abstract: Background and objectives: Data on the association of Mediterranean diet and food groups with depressive symptoms in older men and women, are scarce. The aim of this study was to examine the cross-sectional association of adherence to the Mediterranean diet and its food components with depressive symptoms in an Italian cohort of older men and women. Methods: We included individuals aged ≥ 65 years from the cross-sectional NutBrain study, recruited in 2019–2023, who answered a 102-item semi-quantitative food frequency questionnaire (SFFQ), which was used to calculate the Mediterranean diet score (MDS) proposed by Trichopoulou. Depressive symptoms were assessed using the Center for Epidemiologic Studies Depression Scale (CES-D). The main outcome measure was a CES-D score of 16 or more. Statistical analyses were performed using a logistic regression model controlling for potential confounders. Results: A total of 325 men and 473 women (mean age 73.5 ± 6.2 years, 50.1% low socioeconomic status, 23.9% lived alone) were analysed. The frequency of depressive symptoms was 19.8% (8.0% in men and 27.9% in women). Women with depressive symptoms were less compliant with the MDS and consumed fewer vegetables and fish compared to women without depressive symptoms ($p < 0.05$). No differences were observed in men. Multivariate logistic regression shows that high adherence to the MDS (highest tertile) significantly reduced the odds of having depressive symptoms by 54.6% (OR 0.454, 95%CI 0.266–0.776) in the whole sample, independent of covariates. When we stratified the analysis by sex, we found an inverse association between high adherence to the MDS and depressive symptoms in women (OR 0.385, 95%CI 0.206–0.719) but not in men (OR 0.828, 95%CI 0.254–2.705). Among the MDS components, fish consumption (OR 0.444, 95%CI 0.283–0.697) and MUFA/SFA ratio (OR 0.579, 95%CI 0.345–0.971) above the median were inversely associated with CES-D only in women. Women who ate fresh fish (not canned) 2–3 times/day and ≥ 3 times/week had 43.4% and 70.0% lower odds of depressive symptoms, respectively, than those who ate fish < 2 times/week. Fish consumption was not associated with depression in men. Discussion: This study confirms that older women have higher depressive symptoms than men. Furthermore, high adherence to the Mediterranean diet and high fish consumption were associated with lower depressive symptoms in women but not in men. Our findings provide further evidence that improved advice on healthy eating can benefit mental health, especially in older women.

Keywords: depressive symptoms; older adults; Mediterranean diet; fish intake; cross-sectional study

Author Contributions: Conceptualization, All authors; methodology, F.P., S.C., N.J., E.P., M.C.R., A.C. and S.B.; formal analysis, F.P.; investigation, F.P., S.C., N.J., E.P., M.C.R., A.C. and S.B.; writing— original draft preparation,



F.P.; writing—review and editing, S.C., N.J., E.P., M.C.R., A.C. and S.B.; project administration, F.P.; funding acquisition, F.P. and S.B. All authors have read and agreed to the published version of the manuscript.

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Weight Gain among Children with Severe Malnutrition in Therapeutic Feeding Programmes: A Systematic Review and Meta-Analysis [†]

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Abstract: Background: Although 45 million children under five are wasted, the optimal rate of weight gain during treatment for severe malnutrition is unknown. Historically, inpatient treatment programmes focused on rapid weight gain (WG), with the rationale that this would optimise outcomes. However, recent evidence suggests that too rapid WG might be associated with higher cardiometabolic risk. Our objectives are as follows: describe WG in different programme types (e.g., inpatient, outpatient); explore any association between WG, average length of stay, and mortality/recovery; describe heterogeneity in WG reporting. Methods: For this systematic review and meta-analysis, we searched three databases: Embase (1947–2023), Global Health (1910–2023), and Medline (1946–2023), running the final search on 2nd May 2023. Papers were included if they reported average WG of children aged 6–59 months with severe malnutrition undergoing treatment. Non-English language and grey literature were excluded, except Emergency Nutrition Network Field Exchange articles. Summary data were extracted, and quality appraisal was done using a NICE Quality Appraisal Checklist. We conducted meta-analysis to describe pooled mean WG by programme type. We conducted meta-regression to investigate potential associations of WG with length of stay and programme outcomes. This study is registered with PROSPERO (CRD42023266472). Results: Our search yielded 3001 papers. We reviewed 307 full texts, identifying 127 eligible papers. Of these, 105 papers, with over 240,000 participants in total, reported WG as grams per kilogram per unit time and were eligible for meta-analysis. Mean rate of WG was 9.1 g/kg/d (95%CI 7.9, 10.3) across 19 inpatient programmes, and 3.9 g/kg/d (95%CI 3.5, 4.3) across 58 outpatient programmes. Faster WG was associated with shorter length of stay ($p < 0.001$), but this was moderated by programme type. There was no association between WG and mortality/recovery in unadjusted analyses. There was high heterogeneity between studies. Lastly, 17% of papers did not report WG as grams per kilogram per unit time. Conclusions: Slower WG can be expected in outpatient programmes, compared to

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inpatient programmes. However, this is not an immediate cause for concern because we found no important association between WG and mortality. It may even be beneficial considering long-term cardiometabolic risk.



Keywords: severe malnutrition; weight gain; therapeutic feeding programmes; child health; growth; nutrition; catch-up growth

Author Contributions: Conceptualisation, M.K.; methodology, G.O., D.A., C.O. and M.K.; validation, T.N.-G., K.A., M.A., M.K., L.O. and A.K. (Amir Kirolos); formal analysis, G.O.; investigation, G.O., D.A. and M.K.; resources, M.K.; data curation, G.O.; writing—original draft preparation, G.O., D.A. and M.K.; writing—reviewing and editing, G.O., D.A., T.N.-G., K.A., M.A., A.K. (Amir Kirolos), L.O., D.T., A.K. (Albert Koulman), N.L., A.C.C., CHANGE Study Collaborators Group and M.K.; visualization, G.O.; supervision, M.K.; project administration, M.K.; funding acquisition, M.K. All authors have read and agreed to the published version of the manuscript.

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Beyond Food Safety: How Public and Private Policies Can Guide the Design of Healthier Supermarket Environments [†]

Ana Ines Estevez Magnasco ^{*ID} and Dominic Lemken



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: While policies targeting education in schools, marketing campaigns, and taxation strategies are of great importance to tackle our population's malnutrition, there is growing concern about enhancing the supermarket environment to promote healthier food consumption. Public and private policies targeting the food retail sector can contribute to achieving this goal. Supermarkets play a significant role in presenting food options. As gatekeepers of the food system's impact on consumers' health, they have the power to help people make better food choices. Examples include making healthy checkouts and nudging consumption of vegetables through infographics. Currently, few policies specify how supermarkets' environments could be set up to improve healthy purchases (e.g., the "Partnership for a healthy diet" in Norway and "hange4Life Convenience Stores" in the UK). Furthermore, we see recent shifts in the policy agendas of countries like Germany and Argentina, with new nutrition behavioural policies being legislated and implemented. However, we lack general guidelines that unify the available information on this topic. Addressing this gap has the potential to guide future supermarket policy recommendations. We will perform a review and delve deeper to search for governmental policies and policies of major supermarket brands in selected countries (i.e., Germany and Argentina) to taxonomize the policy initiatives, examining their projects and campaigns designed to improve supermarket environments and encourage consumers to choose healthy options. We will harvest sources published since the release of the SDGs (2015), from ScienceDirect, the FAO policy search engine Informas, and the NOURISHING platform. We will identify the grey literature by searching related websites and databases as well as national government pages or private supermarket policy documents. We will extract the information relevant to policymaking to improve environments in terms of product



reformulation, labelling strategies, placement, product processes, and sweet beverage representation. While spotting incentive, procurement, and regulative policies, we will group them in terms of interventions and further taxonomize the different approaches/initiatives. Our objective is to provide unified policy recommendations by leveraging existing experiences and policies and designing applicable recommendations to improve the food environment in

supermarkets. Furthermore, we aim to promote the creation of science-based policies that consider these recommendations.

Keywords: supermarket; sustainable nutrition; private policies

Author Contributions: Conceptualization, methodology, formal analysis, A.I.E.M.; data curation, A.I.E.M.; writing—original draft preparation, A.I.E.M.; writing—review and editing, A.I.E.M. and D.L.; visualization, A.I.E.M. and D.L.; supervision, D.L. All authors have read and agreed to the published version of the manuscript.

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Socio-Economic Variables Are Associated with Mean Adequacy Ratio in Nigerian Children [†]

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Abstract: Background and objectives: Diet quality is critical for child growth and development. We previously identified a high prevalence of micronutrient inadequacies in Nigerian children's diets. The objective of this study was to identify socio-economic predictors (socio-economic status (SES), main caregivers' education, and household income) of the mean adequacy ratio (MAR), a proxy for diet quality, in this population. Methods: Data from the Ibadan Kids Nutrition and Health Study (I-KNHS) in Nigeria was used to calculate the Nutrient Adequacy Ratio (NAR) for 17 micronutrients.

The MAR was calculated as the average of NARs in children aged both 4–8 years (y) ($n = 510$) and 9–13 y old ($n = 434$). Logistic regression was applied to examine the odds of having an MAR higher than the age group median. Results: The median (interquartile range (IQR)) MAR among 4–8 y old children was higher than that of the older children aged 9–13 y (0.67 (0.23) vs. 0.56 (0.24), $p < 0.0001$), which corresponds to a median of 67% and 56% of micronutrient requirements being met by younger and older children, respectively. Children aged 4–8 y in the highest SES tertile had higher (2.06 (95% CI 1.3–3.25)) odds of having a high MAR compared to the lowest SES tertile. However, this trend was the opposite in 9–13 y old children, with those in the highest SES tertile having lower (0.54 (0.33–0.89)) odds of having a high MAR compared to those in the lowest SES tertile. Higher main caregiver's education and household income were associated with higher MARs in 4–8 y old children, but not in older children. The 4–8 y old children in the highest tertile of household income and main caregiver's education had a higher MAR compared to those in the lowest tertile, with an OR of 1.85 (1.17–2.93) and 2.57 (1.46–4.52), respectively. Discussion: SES, main caregivers' education, and household income were predictors of diet quality. However, contrasting associations were observed between these socio-economic variables and the diet quality between age groups. The cause may be due to older children from the highest SES group having greater freedom to make independent food choices. These findings suggest that interventions to improve the diets of children in Nigeria should address those beyond the lower socio-economic groups.

Keywords: diet quality; children; Nigeria; socio-economic status

Author Contributions: This analyses was conceptualized by L.O., L.-T.T., M.T. and M.A.Z.; The data analyses were carried out by L.-T.T. and M.A.Z.; D.W. and R.S. were responsible for the primary study design. M.T. was responsible for the data visualization. L.O. wrote the abstract. All authors have read and agreed to the published version of the manuscript.

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state of Nigeria (AD13/479/1149 dated 18 March 2019) and UI/UCH Ethics Committee (IAMRAT) (UI/UCH19/0107 dated 15 May 2019).

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Herbal Medicines and Dietary Supplements' Usage and Beliefs among UK Adults: A Cross-Sectional Study [†]

Kyriaki Myrissa *^{ID}, Lauren Gayle, Magali Chohan and Eirini Kelaiditi



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Abstract: Background and objectives: The use of herbal medicines and dietary supplements is rising in popularity, further supporting the increased movement towards self-medication. The present study aimed to gain a better understanding of knowledge and beliefs and to explore sociodemographic factors associated with herbal medicines and dietary supplements usage. **Methods:** A cross-sectional online survey consisting of demographic and socioeconomic information, usage, knowledge and beliefs about herbal medicines and dietary supplements. Participants were eligible to take part if they were over 18 years old and resided in the UK. **Results:** A total of 228 participants took part (71.9% female, and 28.1% male), and 48.7% reported using herbal medicines, while 74.1% reported using dietary supplements. The predominant reason for herbal medicines use was health promotion (75.7%), with the most commonly reported motivation being fewer side effects (50.5%) and safety (40.5%). The majority of participants made decisions about dosage, frequency and length of use based on label instructions (65.8%). Information about herbal medicines and dietary supplements was mainly received from friends (39.9%), family (39.5%) and the Internet (36.8%). Most participants did not inform their doctors about their herbal medicines' usage (71.2%), and those that informed their doctor (28.8%) received little support for their use of herbal medicines and dietary supplements (28.1%). Aloe vera (69.4%), chamomile (55.0%), lavender (54.1%), ginger (53.2%), coconut oil (45.0%), tea tree oil (44.1%), turmeric (43.2%), arnica (43.2%) and garlic (39.6%) were the most popular herbal medicines. Vitamin D (48.7%) and vitamin C (30.3%) were the most popular dietary supplements. Participants with a higher income (>GBP 25,000) were more likely to use herbal medicines (OR: 4.13, 95% CI 1.16–14.72), and those with a higher education level (undergraduate and postgraduate degrees) were less likely to use herbal medicines (OR: 0.18, 95% CI: 0.03–0.98). **Discussion:** Herbal medicines' use is more common in wealthy households, and this has been seen in both developing and developed countries. Highly educated people might seek more modern medical treatments and medications than traditional herbs. A better understanding of the socioeconomic factors that affect herbal medicines and supplement' use will support health policymakers in the design of effective evidence-based interventions.

Keywords: herbal medicines; supplements; survey; socioeconomic

Author Contributions: Conceptualization, K.M., M.C. and L.G.; methodology, K.M. and L.G.; formal analysis, K.M. and L.G.; investigation, L.G.; data curation, K.M. and L.G.; writing—original draft preparation, K.M.; writing—review and editing, K.M., L.G., M.C. and E.K.; visualization, K.M. and L.G.; supervision, K.M.; project administration, L.G. All authors have read and agreed to the published version of the manuscript.

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Fruit and Dairy Intake Is Associated with a Lower Risk of Elevated Blood Pressure in Adults in Sao Paulo, Brazil [†]

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Abstract: Background and objectives: Healthy eating patterns assessed by diet quality indexes (DQI) have been associated with a lower risk of elevated blood pressure (BP). However, DQI are based on different methodologies, and identifying specific components associated with BP may provide a better understanding of the population's dietary profile for targeted interventions. The objective of this study was to examine the association between elevated BP and components of four established

DQI: the 2015 Healthy Eating Index (HEI), the Dietary Approaches to Stop Hypertension (DASH), the Alternative Healthy Eating Index (AHEI), and the Brazilian Healthy Eating Index (BHEI). Methods: The study sample comprised adults aged 19 years and older (n = 1235) from the 2015 Health Survey of São Paulo with Focus on Nutrition, a cross-sectional population-based study in São Paulo City, Brazil. Dietary intake was assessed through 24 h recalls, and diet quality was estimated by adherence to HEI, DASH, AHEI, and BHEI components. The National Cancer Institute method was used to estimate the usual intake of food and nutrients. Multiple logistic regression models were used to investigate associations of BP with components of each DQI, adjusted by sociodemographic, lifestyle, and dietetic variables. Analyses were performed in Stata 14.2, and considered statistical significance at $p < 0.05$. Results: Higher scores in all DQI investigated were associated with being older, female, self-identifying as White or Asian, having higher household income per capita, and being classified as an under-reporter. Individuals with higher scores in dairy components (HEI: OR 0.81, 95%CI

0.70–0.92; BHEI: OR 0.83, 95%CI 0.72–0.96; DASH: OR 0.76, 95%CI 0.60–0.97), and fruit components (HEI: OR 0.72, 95%CI 0.56–0.92; BHEI: OR 0.77, 95%CI 0.61–0.98; AHEI: OR 0.82, 95%CI 0.67–0.99) had a lower occurrence of elevated BP. Discussion: Our findings suggest that the consumption of fruit and dairy within DQI recommendations may provide health benefits regarding BP. The disparities in diet quality across sociodemographic groups of adults in São Paulo City indicate the need for public health messages toward improving food consumption, particularly among those with greater vulnerability.

Keywords: diet quality; blood pressure; cross-sectional study; nutritional epidemiology



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Number 196/96 on research involving human subjects were followed. The 2015 ISA-Capital (protocols 36607614.5.0000.5421), as well as the present study (protocols 48960621.9.0000.5421), were approved by the Institutional Review Board of the School of Public Health, University of São Paulo.

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How Much Do Pregnant Women Adhere to a Healthy Dietary Pattern? Dietary Changes throughout the Last Trimester of Pregnancy—The Dastatuz Trial [†]

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Abstract: Fruits and vegetables (FV) are part of a healthy diet. How does a FV-rich diet during pregnancy influence the forthcoming baby's eating behavior? The Dastatuz project aims to answer this question. Two groups were established: mothers with a standard FV intake (SD) and mothers with a higher FV intake (HFV). This study examined the dietary profiles of both groups ($n = 110$) during the last trimester of pregnancy as well as sociodemographic aspects and feeding expectations. The participants did not differ in their baseline characteristics but showed significantly different dietary patterns. At the seventh month of pregnancy, 54.5% and 38.2% of the participants met the recommendations for fruit and vegetables intake, respectively. After 2 months of dietary follow-up, the percentages increased to 72.6% for fruits and 56.2% for vegetables. In both time points, the HFV group had a higher FV intake compared to the SD group. In conclusion, a current picture of food intake during pregnancy was offered, based on a Western European population. The results suggested that, still, further efforts should be made to encourage an increase in FV intake. The Dastatuz project is an ongoing program; therefore, the results will be updated in future publications. Meanwhile, these preliminary results confirmed that the control and intervention groups were comparable, as they only differed in their diet. This will make it possible to study “mothers' FV intake” as a possible early factor influencing children's future eating behaviors.

Keywords: fruit and vegetable; pregnancy; recommendations; follow-up

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Laetitia Guérin-Deremaux ¹, Caroline Perreau ^{1,*} , Catherine Lefranc-Millot ² and Saskia De Jong ³



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Abstract: The objectives of the present research were to investigate (1) the nutritional quality through the Protein Digestibility-Corrected Amino Acid Score (PDCAAS); (2) the apparent viscosity under simulated in vitro gastric conditions of two pea protein isolates named NUTRALYS[®] pea protein and NUTRALYS[®] S85 Plus. In the first study, the in vivo protein digestibility was measured according to the methodology recommended by the FAO/WHO in 1991. Growing rats were fed a diet containing 10% proteins or a protein-free diet during a minimum of a 5-day balance period with daily collection of faeces. The true digestibility was measured using the rats' nitrogen intake and fecal nitrogen. PDCAAS was calculated using the amino acid profile and the protein digestibility. In the second study, in vitro gastric digestion was simulated using the NIZO SIMPHYD model. The profiles of “fast-” or “slow-digested” proteins were evaluated and compared to whey and casein proteins by measuring the evolution of the viscosity in these conditions. Both of the tested proteins displayed a balanced amino acid profile with high concentrations of arginine, branched-chain amino acids, lysine and glutamic acid. The true protein digestibility of NUTRALYS[®] pea protein and NUTRALYS[®] S85 Plus were 97% ± 2 and 96% ± 3, respectively. According to the FAO/WHO requirement profile (2007) mainly used in Europe for adults or the profile from 1991 mainly used in the United States for all age groups except infants, the PDCAAS results of NUTRALYS[®] pea protein were 93 and 81, respectively. The PDCAAS scores of NUTRALYS[®] S85 Plus were 92 and 81, respectively (Study 1). The digestion of NUTRALYS[®] pea protein resulted in a clear increase in viscosity during the gastric acidification and a sudden drop in viscosity after the addition of the gastric enzymes. The viscosity profile of NUTRALYS[®] S85 Plus did not change during digestion (Study 2). The range of pea proteins evaluated in these studies displayed a high nutritional quality profile. NUTRALYS[®] pea protein is an “intermediate-fast protein” and NUTRALYS[®] S85 Plus is a “fast-digested protein”, meaning that these ingredients can be adapted to specific nutritional needs. These results show that plant-based proteins, like those of the NUTRALYS[®] range, may allow us to design high-quality protein.

Keywords: plant-based; protein; nutritional quality; viscosity; fast-protein

Author Contributions: Conceptualization, L.G.-D. and S.D.J.; methodology, L.G.-D., C.P. and S.D.J.; software, S.D.J.; validation, C.P. and S.D.J.; formal analysis, C.P. and S.D.J.; investigation, C.P. and S.D.J.; resources, C.P. and S.D.J.; data curation, C.P. and S.D.J.; writing—original draft preparation, L.G.-D. and S.D.J.; writing—review and editing, L.G.-D., S.D.J., C.L.-M. and C.P.; visualization, S.D.J. and C.P.; supervision, S.D.J.; project administration, L.G.-D.; funding acquisition, L.G.-D. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data available on request due to restrictions (privacy, legal and ethical reasons).



Abstract

Conflicts of Interest: Catherine Lefranc-Millot, Laetitia Guerin-Deremaux and Caroline Perreau are employees of ROQUETTE FRERES, that provided financial support for this research.

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Abstract

Effect of Mediterranean Diet Adherence and Its Interaction with Genetic Susceptibility to Obesity on Adiposity in European Children: The IDEFICS/I.Family Study [†]

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and Luis A. Moreno ^{1,2} 



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Abstract: Introduction: The Mediterranean Diet (MD) has been associated with a better adiposity profile in different cohorts of European children. However, these beneficial effects might be influenced by genetic variations, which could potentially modulate the MD–adiposity association. Objectives: To investigate if higher adherence to the MD, or any of the MD food groups, is associated with lower adiposity during youth. Also, to observe the degree by which the adherence to the MD or any of the MD food groups could modulate the genetic susceptibility to obesity, in relation to adiposity. Methods:

Design: Cohort study with three measurement surveys: baseline (T0), follow-up 1 (T1), and follow-up 2 (T3), between 2007 and 2014. Setting: The pan-European IDEFICS/I.Family cohort. Participants: 3098 children aged 2–16 years were genotyped. A total of 1907 participants at time measurement 3 (T3) were included, with complete information in all parameters of interest. Outcome measures: body mass index (BMI) and waist circumference (WC). A 7-item Mediterranean Diet Score (MDS) to assess the degree of MD adherence, and a genome-wide polygenic risk score (PRS) for BMI previously built within the IDEFICS/I.Family consortium, from a previous GWAS to capture obesity risk. Statistical analysis: In T3, multiple linear regressions to test MD–adiposity and MD-food-groups–adiposity associations, adjusted by age, sex, parental education, genetic susceptibility to obesity, population stratification, region of residence, screen sedentary time (SST), and physical activity. Then, the same models were used to estimate gene x diet effects, based on the PRS x MD adherence. Results: No associations were found between MDS and BMI or WC adiposity markers (p -value 0.26, B 0.10). In terms of food groups, higher vegetable consumption was inversely associated to BMI (p -value < 0.01 , B -0.01) and WC (p -value 0.01, B -0.02), although no gene x vegetables interaction effects were found (BMI p -value 0.43, B < 0.01 ; WC p -value 0.49, B 0.01). Age and SST were also significantly associated to BMI (p -value 0.01, B -0.12 ; p -value < 0.01 , B 0.02), and only SST to WC (p -value 0.03, B 0.05), respectively. Conclusions: Higher consumption of vegetables might be associated with lower obesity, irrespective of their obesity genetic risk.

Keywords: Gene x diet; polygenic risk score; Mediterranean diet; BMI; children

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of each participating country.

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7. Spain: Ethics Committee for Clinical Research of Aragon (CEICA), 20/06/2007, ref: No. PI07/13 and 13/Feb/2013, No. PI13/0012
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Data Availability Statement: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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The Association between a Healthy Diet and Quality of Life Results from the Population-Based FinHealth 2017 Study [†]

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Abstract: Background and objectives: In general, a healthy diet is a key lifestyle factor when it comes to guaranteeing a good quality of life (QOL). Evidence of the association between overall diet and QOL in the general adult population, however, remains limited. Consequently, our aim was to assess whether better overall diet quality is associated with better QOL in Finnish adults. Method: This cross-sectional study was based on the nationally representative FinHealth 2017 Study. Our study population comprised 4846 men and women aged 25 or older. Diet was assessed with a validated 134-item food-frequency questionnaire (FFQ). Overall diet quality was measured by the modified Baltic Sea Diet Score (mBSDS; range 1–22; higher scores indicated better diet quality) consisting of eight components: fruits, vegetables, whole-grain products, low-fat milk, fish, red and processed meat, fat quality, and alcohol. QOL was measured using the EUROHIS-QOL 8-item index (EUROHIS-8). The overall EUROHIS-8 score was calculated by summing the scores for the eight items. The mean value (range 1–5; a higher value indicated a better QOL) of the overall EUROHIS-8 score was used. The mean values of overall EUROHIS-8 according to quintiles of mBSDS based on predictive margins were analyzed using linear regression models adjusted for age, sex, education, marital status and energy intake. The sampling design and non-response were taken into account. Results: Higher dietary quality was associated with better QOL. The EUROHIS-8 mean values increased consistently from the first quintile (Q1) to the fifth (Q5) of mBSDS: Q1 3.88 (95% CI 3.84, 3.93); Q2 3.96 (3.92, 4.00); Q3 3.97 (3.93, 4.02); Q4 4.04 (4.00, 4.09); Q5 4.10 (4.07, 4.14) (p for trend < 0.01). The results were similar for both sexes and for younger (<65 years) and older age groups. Discussion: These findings suggest that a healthy diet is associated with better QOL. Our results reinforce the earlier evidence by providing new findings based on large, population-based data, standardized measures and focusing on overall diet quality as exposure. From the public health perspective, it is important to reveal the full potential of a healthy diet in improving QOL.

Keywords: diet quality; Baltic sea diet score; quality of life; population-based; adults



N.E.K.; data curation, T.J. and K.H.; writing—original draft preparation, T.J. and N.E.K.; writing—review and editing, S.M. and K.H. All authors have read and agreed to the published version of the manuscript.

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Author Contributions:

Conceptualization, T.J. and N.E.K.; methodology, T.J., S.M. and N.E.K.; formal analysis, T.J. and K.H.; investigation, T.J. and

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B-Vitamin Biomarkers in Relation to Immune Function in Older Adults: Preliminary Analysis from the TUDA Study [†]

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Abstract: Background and objectives: Immune function typically declines with age, increasing susceptibility to disease. Many factors contribute to this decline, including nutritional status. Emerging evidence shows associations of folate and related B-vitamins (B12, B6, and riboflavin) with immune health, but these interactions are complex. The aim of this study was to investigate B-vitamin biomarkers in relation to immune function in ageing. We hypothesised that the higher status of certain B-vitamins will be associated with improved inflammatory markers. Methods: The data were analysed from the Trinity-Ulster-Department of Agriculture (TUDA) study, aimed at investigating health and lifestyle factors in relation to disease, in community-dwelling older adults recruited from the island of Ireland (2008–2012). Of the 5186 TUDA participants, 2724 fulfilled the inclusion criteria for the current investigation. We measured B-vitamin biomarkers, namely, red blood cell folate, serum B12, plasma pyridoxal-5-phosphate (PLP; B6), the erythrocyte glutathione reductase activation coefficient (EGRac; riboflavin), pro-inflammatory markers (interleukin IL-6, tumor necrosis factor-alpha [TNF- α], and c-reactive protein [CRP]), and the anti-inflammatory marker (IL-10). Results: Plasma PLP was negatively associated with CRP (β : -0.066; 95% CI: -0.005–0.000; p = 0.020), and plasma homocysteine was positively associated with CRP (β : 0.062; 95% CI: 0.003–0.066; p = 0.030) and TNF- α (β : 0.086; 95% CI: 0.023–0.124; p = 0.004). No other significant associations between B-vitamins and inflammatory markers were found. As regards general characteristics, the concentrations of IL-6 (p = 0.040) and CRP (p = 0.010) increased with age; CRP (p < 0.001); TNF- α (p = 0.024) increased with BMI; higher IL-6 (p = 0.041) was associated with living alone; and higher CRP (p < 0.001) was associated with smoking. Discussion: These preliminary findings suggest that improving vitamin B6 status and maintaining a healthy weight in older age may support a healthier immune system. Further investigation, particularly in the form of randomised controlled trials, is required to confirm the current findings and investigate the impact of B-vitamins on immune function.

Keywords: B-vitamins; vitamin B6; inflammatory markers; CRP; ageing



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Oral Nutritional Supplementation Supports Achievement of Developmental Skills, Temperament Traits, and Parent-Reported Toddler Quality of Life in Toddlers Experiencing Growth Concerns [†]

Tinu Mary Samuel ^{1,*}, Dominik Grathwohl ², Jodi Bettler ¹, Purva Rajhans ³, Jowena Lebumfacil ⁴, Rachel Lawenko ⁵ and Elvira Estorninos ⁵



Citation: Samuel, T.M.; Grathwohl, D.; Bettler, J.; Rajhans, P.; Lebumfacil, J.; Lawenko, R.; Estorninos, E. Oral Nutritional Supplementation Supports Achievement of Developmental Skills, Temperament Traits, and Parent-Reported Toddler Quality of Life in Toddlers Experiencing Growth Concerns.

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Abstract: Background and objectives: Oral Nutritional Supplements (ONS) is shown to impact growth in nutritionally at-risk children, however, effects on developmental progress and behavior are not well elucidated. We aimed to assess the effect of ONS combined with dietary counselling (DC) on the achievement of developmental skills, temperament traits, and parent-reported toddler quality of life in 1–3-year-old children in the ≤25th weight-for-length percentile. Methods: In this prospective single-arm, open-label intervention study (N = 108), Filipino children received 2 servings/day of ONS, plus DC for 16 weeks. The ONS was energy and nutrient dense with increased levels of vitamin A, iron, and zinc (growth-limiting micronutrients), as well as DHA and phospholipids, including sphingomyelin. Developmental milestone achievement, temperament traits, and toddler health-related quality of life scores were assessed using the Ages and Stages Questionnaire (ASQ-3), Early Childhood Behavior Questionnaire (ECBQ-SF), and Infant and Toddler

Quality of Life Questionnaire Short Form (ITQOL-SF47), respectively, at both baseline and week 16. Change scores were analyzed by ANCOVA, correcting for baseline measure, age, and sex. Results: The children's mean age at baseline was 21.3 ± 6.6 months and 44.4% were male. There was a significant increase ($p < 0.01$ for all) in scores for language, motor, cognitive, and social developmental domains from baseline to week 16. Temperament scores related to social skills and behavioral regulation including cuddliness, high intensity pleasure, low intensity pleasure, perceptual sensitivity, positive anticipation, sociability, surgency, and effortful control all increased significantly ($p < 0.05$ for all) from baseline to week 16. The scores on several parent-reported aspects of child well-being such as satisfaction with their child's growth and development (including physical growth, motor and language development, responsiveness to others, and learning abilities), their child's overall behavior (including the ease of managing it), their child getting along with others (including less tantrums, responding positively to affection, and listening and following directions), and their child's health increased significantly ($p < 0.05$ for all) from baseline to week 16. Conclusion: ONS combined with DC in toddlers experiencing growth concerns supports developmental skills and temperament traits essential for learning, as well as parent-perceived toddler quality of life.

Keywords: Oral Nutritional Supplements; toddlers; developmental skills; temperament; quality of life

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Oral Nutritional Supplementation Combined with Dietary Counselling Promotes Growth and Nutritional Adequacy, and Is Well Accepted in Toddlers Experiencing Growth Concerns [†]

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Abstract: Background and objectives: Adequate nutrition is a key determinant of growth in children, and Oral Nutritional Supplement (ONS) represents an important strategy to improve growth and nutritional adequacy in nutritionally at-risk children. We aimed to assess the effect of ONS combined with dietary counselling (DC) on the growth and nutritional adequacy in 1–3-year-old children \leq 25th weight-for-length percentile. Methods: In this prospective single-arm, open-label intervention study (N = 108), children received 2 servings/day of ONS plus DC for 16 weeks. The ONS was energy and nutrient dense, with increased levels of vitamin A, iron, and zinc (growth-limiting micronutrients), as well as DHA and phospholipids, including sphingomyelin. Anthropometric assessments were performed at baseline and weeks 3, 6, 9, 12, and 16. Change scores from baseline to week 16 were analyzed by a mixed model adjusted for age, sex, and baseline, and was corrected for regression to mean. Nutrient intake was assessed using three-day food intake diaries at baseline, week 6, and week 16. Nutritional adequacy was estimated by comparing against the Estimated Average Requirements, based on the Philippines Dietary Reference Intakes. Acceptance of the ONS was assessed using a toddler milk satisfaction questionnaire. Results: The children's mean age at baseline was 21.3 ± 6.6 months and 44.4% were male. Weight (0.740 kg) and height (3.02 cm) significantly increased ($p < 0.001$) from baseline to week 16 including at weeks 3, 6, 9, and 12. There was a significant increase in change score for weight-for-height (0.188 SD), weight-for-age (0.146 SD), height-for-age (0.062 SD), and BMI-for-age (0.163 SD) Z scores, and intakes of energy, protein, and critical micronutrients, such as zinc, iron, selenium, and vitamins A, B1, B3, B6, B9, B12, C, and D, all significantly increased from baseline to week 16 ($p < 0.05$ for all). The percentage of children achieving nutrient adequacy increased ($p < 0.05$) and reached close to 100% for iron, zinc, calcium, and vitamins A, B1, B3, B6, B9, B12, and C. Compliance to the ONS intake was high (86%) and 99% reported their overall opinion on the product to be good, very good, or excellent. Conclusion: ONS combined with DC promotes growth and nutritional adequacy, and is well accepted in toddlers with growth concerns.

Keywords: Oral Nutritional Supplementation; growth; nutrient intakes; nutritional adequacy; toddlers

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Dietary Phytochemical Index in School-Age Children: Sociodemographic and Lifestyle-Related Factors [†]

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Abstract: Plant-based foods are known to be rich in nutrients, but they are also a good source of phytochemicals that have a positive effect on health. However, it appears that children in EU countries consume less plant-based foods and thus have a low phytochemical intake. Therefore, the aim of this study was to estimate the dietary phytochemical index (DPI) in children and to investigate the relationship between DPI and sociodemographic and lifestyle factors. DPI was estimated from the 3-day dietary records of 195 children (52% boys; 8.9 ± 0.4 years) from 14 primary schools in the city of Zagreb (school years 2018/2019). Sociodemographic and lifestyle factors were observed using a general questionnaire and a physical activity questionnaire for older children. Anthropometric measurements were performed according to standard protocols, while z-scores were obtained using AnthroPlus v.1.0.4. software. The mean DPI was 11.8 (7.7–16.2) in the total sample of children. In this study population, DPI was most influenced by fruit (39% of DPI) consumption, followed by whole grains (31%), vegetables (22%), and other foods (7%) such as olive oil, herbal drinks, herbs, tea etc. No association was found between DPI and weight status, sleep duration, sedentary behavior, physical activity level, parents' education level, and household income. However, sex was significantly weakly correlated with DPI ($r = 0.146$; $p = 0.041$), with girls having a significantly higher DPI (12.4; 9.5–17.7) compared to boys (10.3; 7.6–15.3). This difference is significant, as further analysis revealed that girls consumed more dried fruits ($p = 0.006$) and nuts ($p = 0.031$) than boys. Although there is no recommendation for phytochemical intake, nor for an appropriate DPI, the children in the present study have a lower DPI compared with the DPI estimated in the available literature for a similar population. Girls had a higher DPI than boys, but only because they consumed more dried fruits and nuts. It has not been demonstrated that this low DPI score is related to other sociodemographic and lifestyle factors. Further research is needed to determine which factors and their combination may influence DPI and whether these factors are equally pronounced in children with higher or lower DPI.

Keywords: childhood; child; determinants of eating behavior; dietary patterns; dietary phytochemical index; phytochemicals

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Data Availability Statement: The data are available upon request from A.I.

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Food Choices, Physical Activity, and Prevention of Cardiovascular Diseases in Young Adult Albanians: Assessment of Nutritional Status in University Students and the Risk of Chronic Degenerative Diseases [†]

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Abstract: Objectives: This study aims to evaluate the food intake, physical activity, and risk of cardiovascular diseases among young adult Albanians, considering their nutritional status and lifestyle. As Albania undergoes a transition from a rural to a more westernized society, changes in lifestyle and dietary habits have been observed, leading to an increase in overweight and obesity among adults. Materials and Methods: The study included 120 young adult Albanians (65 males, 55 females) aged 18–27. Body composition, blood pressure, anthropometry, and Body Mass Index (BMI) were measured. A standardized questionnaire on food frequency and physical activity was administered. Results and Findings: The results indicated that males tended to have a higher prevalence of overweight and obesity compared to females. Significant differences were observed in blood pressure levels based on fat mass, waist, and hip circumferences. Obese individuals exhibited higher blood pressure, engaged in less physical activity, and had less healthy eating habits. Moreover, a significant proportion of participants reported irregular meal patterns and inadequate breakfast consumption. Conclusions: The findings highlight the need for interventions targeting proper nutrition and physical activity in young Albanians to mitigate the increasing risk of overweight/obesity and cardiovascular diseases. This study contributes to understanding the nutritional habits and associated health risks in a young adult population undergoing socio-economic changes.

Keywords: food intake; physical activity; Albanians; nutritional status

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Informed Consent Statement: Informed consent was obtained from both parents of the children involved in the study.

Data Availability Statement: Data are unavailable due to privacy.

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Assessment of Body Weight, Body Height and Body Fatness in Albanian Children Aged 7–15 Years and Comparison with International Standards, and Follow-Up at One Year [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Objectives: In Albania, a large number of infant and young child have a poor nutritional status. At the same time, the population is undergoing a nutrition transition, and the prevalence of overweight and obesity is high among adults. Few data are available on the nutrition status of those aged between 6 and 18 years in Albanian. The aim of this study was to evaluate the nutritional status of Albanian children and conduct a one-year follow-up. Methods: In Yilber Elementary School in Tirana, body composition (FAT, FFM, TBW) by BIA (RJL device) was measured in 314 children,

151 boys and 163 girls, aged 7–15 years. Food intake was also measured with a food questioner. Height and weight were compared with the international reference values. One year after the first survey, the same baseline parameters were measured in the same sample population of children to verify growth trends in order to detect any significant changes in the parameters being studied. Results: A significant difference was detected between the sexes in terms of fat mass (FM), with a significantly higher value for girls ($p = 0.049$). The prevalence of underweight, overweight, and obesity for Albanian children (7–15 years) was quite a bit lower than the references; on the contrary, overweight was higher for boys and girls aged 9 years. Frequency for overweight or obese increased with age. In the follow-up, there was a significant increase in weight, height and BMI, lean mass, total body water, and fat mass in both sexes. Body cell mass index did not change in males. Significant height increases were detected in both sexes for all age groups, except for children aged 11 and 13. The most significant changes were observed for 11-year-old females, while for males, the findings appear to be homogeneous across all ages, which is consistent with the typical phases of male development. Conclusions: An important percentage of Albanian children are at risk of being overweight or obese, which requires more attention because the development of obesity results in different types of diseases associated with changes in body composition. Improvements in healthcare and efforts in nutrition education are needed to prevent the transition to obesity and chronic diseases.



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Keywords: Albanian children; body composition; bioelectrical impedance

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The Association of Oral Processing and Salivary Flow Rate on Food Intake and Appetite in Older Adults (Aged ≥ 65 Years) [†]

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Abstract: Loss of appetite in older adults is common and can lead to reduced food intake, increasing the risk of malnutrition, frailty, and mortality. In addition, older adults often experience age-related deterioration in oral processing ability, saliva flow and chewing efficiency, which can further reduce food intake. This observational study investigated individual variations in these factors and their relative influence on food intake and appetite in healthy adults aged ≥ 65 years. After overnight fast, stimulated and unstimulated saliva samples were collected. A breakfast meal was provided, which was video recorded to enable a subsequent behavioural annotation of bites, chews and swallows using the software “ELAN”. Fasting and postprandial blood glucose were measured. Chewing efficiency was assessed using a two-colour chewing gum mixing ability test and the opto-electronic software ViewGum© (version 4.1.2.1). Saliva uptake was assessed using standard test food, and questionnaire data were collected to assess oral health, lifestyle and sensory preferences. Appetite was assessed subjectively using visual analogue scales for three hours after breakfast and objectively through an ad libitum lunch. Preliminary results from 44 participants (median age 72.5 years, BMI 25.6 kg/m², 22 males) are presented (target sample size of the study is 86 participants). Males were observed to be faster eaters, with larger average bite size and higher saliva uptake values. Faster eaters had a larger ad libitum meal intake and consumed their meal with a larger average bite size, fewer chews per gram, and shorter total oral exposure time. Individuals with a faster eating rate consumed more food and these differences were associated with differences in subjective satiety ratings, postprandial blood glucose and stimulated saliva flow. No differences in chewing performance were observed. This study is the first to explore the association between oral processing and salivary factors with food intake and appetite in older adults. The preliminary results show that variability between individuals can influence food intake, glucose metabolism and post-meal satiety. This study will provide a foundation for better understanding the food needs of older adults and assist in designing appropriate food products for them.



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Dietary Intakes of Sugar in the Student Population from Fruits and Beverages [†]

Margarita Dodevska ^{1,*} , Jelena Kukic-Markovic ², Nevena Ivanovic ³ , Tamara Perisic ³ and Verica Jovanovic ¹



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Abstract: Objectives: A healthy diet includes the intake of sugar (up to 5%) from natural sources, because added sugars increase energy but not nutritional value, and are associated with an increased risk of developing obesity, cardiovascular diseases and hypertension. Sugars present in fresh fruit, fruit juices and nectars, refreshing soft drinks and alcoholic drinks usually represent half of the total sugar intake. The aim of this study was to analyze, through surveys, the habits of the student population regarding the consumption of food from the sources mentioned and to determine the amount of sugar consumed. Methods: 123 students (male: 36, female: 87), aged 19 to 32, participated in this research. Data collection was voluntary and anonymous, and the survey was conducted using an electronic questionnaire during February 2023. The data on the sugar content of the foods mentioned were taken from the declarations of the products that are available for free sale. Results: Based on the processed results from the completed questionnaires, it was concluded that from the sources mentioned, sugar is represented by 3.7% in relation to the total energy intake, and added sugar by 2.4% if 2000 kcal/day is consumed. In relation to the representation of carbohydrates of 60% in relation to the total energy intake, the sugar content from the tested sources accounted for 6.3%, and added sugar accounted for 4.0%. Students reported that they most often do not consume hard liquor (88% of respondents), and that they eat a teaspoon of honey/sugar once a day (14% of respondents). Conclusion: Although the obtained results are very acceptable and encouraging, it is necessary to act additionally in terms of increasing awareness of the reduced intake of products with added sugars and their replacement with those that contain biologically active compounds in addition to natural sugar composition.

Keywords: sugar intake; questionnaire; student population; fruit; beverage

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Factors Associated with Daily Consumption of Fruits and Vegetables in Serbia [†]

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Abstract: Background and objectives: The beneficial effects of fruit and vegetable consumption on general health are well known. Daily consumption of both fruit and vegetables is therefore considered to be an indicator of a healthy diet and lifestyle. The study aimed to investigate the frequency and factors that contribute to daily consumption of both fruits and vegetables in the Serbian adult population. Methods: For the purpose of this study, we used data from the freely available registry from the national general health survey of the Serbian adult population that was performed in 2019. Data were statistical analyzed using the Statistical software for Social Sciences SPSS 22.0. Results: A total of 31.3% of the participants (4123/13,178) reported daily consumption of both fruit and vegetables. Multivariate logistic regression analysis showed the association between daily consumption of both fruit and vegetables with female sex (OR: 1.44; 95% CI: 1.32–1.58), older age (OR: 1.01; 95% CI: 1.00–1.01), having the highest quintile (OR: 1.52; 95% CI: 1.31–1.78), having a secondary (OR: 1.30; 95% CI: 1.16–1.46) or tertiary level of education (OR: 1.75; 95% CI: 1.51–2.02), having good (OR: 1.29; 95% CI: 1.08–1.53) or average self-rated health (OR: 1.25; 95% CI: 1.06–1.47), being a non-smoker (OR: 1.38; 95% CI: 1.25–1.52) and performing sufficient physical activity (OR: 2.01; 95% CI: 1.34–3.02). Discussion: The obtained results indicate that in Serbia, older females, nonsmokers, those with a higher level of education and better income and those who perform regular physical activity most commonly consume both fruits and vegetables on daily bases. Because a higher intake of fruits and vegetables improves public health, adequate and regular education of healthy nutrition at the individual and community levels is suggested. This education in Serbia should particularly be tailored towards younger men with generally unhealthy lifestyles (physically inactive smokers) and a low level of education, as they appear to consume fruits and vegetables the least.

Keywords: fruits; vegetable; healthy diet

Author Contributions: M.M., J.T. and J.D. designed the study, performed data analysis and literature review and wrote the paper. All authors have read and agreed to the published version of the manuscript.

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The Influence of a School Environment on Obesity in Children [†]

Katerina Mihajlova ^{1,*} , Aleksandra Stamenova ¹  and Igor Spiroski ^{2,3}

Belgrade, Serbia, 14–17 November 2023.

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[†] Presented at the 14th European Nutrition Conference FENS 2023,

Abstract: Background: Obesity is a complex, multifactorial and widespread condition that affects all age groups of children. The rising prevalence of childhood obesity has become an important public health challenge because it affects the physical and mental health of children and is becoming an economic burden on the health systems. North Macedonia, as part of WHO's Childhood Obesity Surveillance Initiative (COSI), is collecting data to show the importance of the surveillance of obesity in school-aged children and to provide evidence for informed policy making. Objectives: The aim of this cross-sectional study is to further investigate the influence of a school environment on obesity in 7-year-old schoolchildren and therefore improve children's nutrition by targeting the food environment in and around schools. Materials and methods: Anthropometric measurements of body height and body weight were performed, and data from a school environment were collected, following the COSI protocol and data-collecting procedures. Results: The results from the previous rounds show that the overweight (including obesity) prevalence in 7–9-year-old schoolchildren is 31%. While physical education lessons in schools consist of 120 minutes of physical activity per week, only one-third of the schools studied organize sport activities outside school hours, and 39% of schools do not have indoor gyms. Only 31.2% of the schools are free of sugary beverage and calorie-dense food advertisements, but there are nutritional education classes in the curriculum in almost every school. One-third of the schools provide fresh fruit and one-third have vending machines on their premises, enabling children to acquire unhealthy snacks and beverages other than water and fruit juice. Conclusion: By comparing the previous and latest anthropometric data, there is a rising trend of childhood obesity in the country. School environments should be improved towards providing healthier nutrition and physical activity practices for pupils.

Keywords: school food environment; children; nutrition; obesity; school environment

Author Contributions: Conceptualization, K.M., A.S. and I.S.; methodology, I.S.; software, I.S.; validation, I.S., K.M. and A.S.; formal analysis, I.S.; investigation, I.S., K.M. and A.S.; resources, I.S. and K.M.; data curation, K.M. and I.S.; writing—original draft preparation, K.M. and I.S.; writing—review and editing, K.M., I.S. and A.S.; visualization, K.M.; supervision, I.S.; project administration, I.S.; funding acquisition, I.S. All authors have read and agreed to the published version of the manuscript.

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The Effect of Protein and Protein Source on Appetite in Older Adults: Preliminary Findings from the FortiPhy Study [†]

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Abstract: Background and objectives: Reduced appetite is known to be an important determinant of malnutrition in older adults. To prevent malnutrition, fortification with high-energy/high-protein ingredients has been suggested to be a relevant approach. Protein is considered to be the most satiating macronutrient in the younger population, and it therefore may cause a decrease in overall energy intake. However, the effect of protein intake on satiety in older adults is unclear. Therefore, the objective of this study was to assess the effect of the meals fortified with protein from different sources on satiety and appetite. Methods: In this single-blind randomised crossover study, the effect of protein fortification on satiety and appetite was investigated in 10 healthy older adults (n = 7 women and n = 3 men) with a mean age of 76 (SD 3) years and a BMI of 23.7 (SD 2.6). Participants consumed one of the iso-energetic test meals of porridge (unfortified control, fortified with dairy protein, or fortified with plant protein), and four hours after were offered an ad libitum meal. Appetite was assessed using a 100mm visual analogue scale at baseline and every 30 mins throughout the test day and total daily energy intake was assessed by a weighed food diary. Differences in appetite and energy intake were assessed using repeated measures ANOVA. Results: No difference was found in energy intake at the ad libitum meal consuming the different porridge test meals fortified with animal and plant-based protein and unfortified control porridge (control 402 (SD 194), dairy protein: 286 (SD 105), plant protein: 353 (SD 156) kcal, respectively) or energy intake for the rest of the day. There were also no differences in subjective measures of hunger, fullness, wanting, and desire to eat food after consuming the different test meals. Discussion: Our data do not indicate that fortification with protein results in a significant decrease in energy intake in older adults. However, these findings are based on preliminary analysis and the fully powered dataset is required to draw a firm conclusion on the role of protein fortification on appetite in older adults.

Keywords: aging; protein; appetite



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Can Milk-Derived Calcium Permeate Attenuate Loss of Bone Mineral Density in Postmenopausal Women? The 12 mo RENEW Randomized Intervention Study [†]

Inge Tetens ^{1,*} , Sidse Ida Ingemann Rasmussen ¹ , Mai Østerø Cramon ², Caroline Filskov Petersen ¹, Sadime Basak Kisi Kaki ¹ and Mette Friberg Hitz ²



Citation: Tetens, I.; Rasmussen, S.I.I.; Cramon, M.Ø.; Petersen, C.F.; Kaki, S.B.K.; Hitz, M.F. Can Milk-Derived Calcium Permeate Attenuate Loss of Bone Mineral Density in Postmenopausal Women? The 12 mo RENEW Randomized Intervention Study. *Proceedings* **2023**, *91*, 192. <https://doi.org/10.3390/proceedings2023091192>

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Abstract: Background: An earlier study showed different metabolic responses to intake of an acute calcium load from milk-derived calcium permeate (CP) and calcium carbonate (CC). The long-term and clinical implications for bone maintenance are unknown. Objective: To investigate the effects of 12-month supplementation with CP, taken alone or in conjunction with inulin, on changes in bone mass density (BMD) and bone turnover markers (BTMs) in apparently healthy postmenopausal women compared with CC or placebo. Methods: A 12-month randomized controlled doubleblinded multi-center intervention trial was conducted with healthy postmenopausal women with adequate vitamin D status. During the trial, participants received maltodextrin (placebo), 800 mg calcium as CC, or 800 mg calcium as CP (Capolac[®]MM-0525 BG, Arla Foods Ingredients Group P/S, Viby J, Denmark) without or with 12 mg of inulin and divided into two daily doses of capsules and sachets. A daily vitamin D supplement of 20 µg was provided. At baseline and at the end of the study, BMD was assessed by DXA scan, and anthropometric measures were obtained together with fasting blood samples for measurements of BTMs (CTX and P1NP), serum iPTH, vitamin D, serum calcium, creatinine, phosphate, and triglycerides. Habitual dietary intake was assessed using the online system Myfood24, where subjects recorded their dietary intake for 7 consecutive days, and physical activity was assessed by the International Physical Activity Questionnaire. Socioeconomic data and physical activity were obtained through questionnaires. Preliminary results: A total of 417 women were eligible according to the inclusion and exclusion criteria and were included over a 12-month period. At present, 239 subjects have completed the study. The intervention will end in June 2023. Baseline characteristics (mean ± SD) are age 55.4 ± 4.17 years; height 167.4 ± 5.73 m; body weight 71.5 ± 11.7 kg; BMI 25.5 ± 3.78; hip circumference 102.3 ± 9.48 cm; and waist circumference 84.09 ± 10.0 cm. The BMDs expressed as t-scores were L-total −0.46 ± 1.17 and Neck-total −0.88 ± 0.80. Discussion: The recruitment of eligible participants was delayed due to COVID but was successful within one year. The drop-out rate has been larger than expected. More results will be ready to be presented at the conference.

Keywords: calcium carbonate; calcium supplementation; inulin; bone mass density; BMD; CTX; P1NP; RCT; diet; myfood24

Author Contributions: Conceptualization, design and methodology: I.T. and M.F.H.; Investigation: S.I.I.R., M.Ø.C., C.F.P. and S.B.K.K.; Resources: I.T. and M.F.H. All authors have read and agreed to the published version of the manuscript.

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Our Experience in Testing Potential Prebiotics [†]

Nikoleta Lugonja ^{1,*} and Miroslav M. Vrvic ²



Citation: Lugonja, N.; Vrvic, M.M.

Our Experience in Testing Potential Prebiotics. *Proceedings* **2023**, *91*, 187.

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract:

Background/objectives: Normal growth and development of the human gastrointestinal tract

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begins at the earliest age of life. The microbiota is a complex system and there are numerous efforts to influence these microbial species in order to improve health. Prebiotics with probiotics act synergistically in organisms, so they represent supplements or food ingredients specifically intended for this role. In children, analyzing the microbial composition can determine the potential for obesity later in life, which is why the influence of nutrition in the earliest period is an important factor, especially for preterm infants. Human milk is the best source of nutrients, but in cases when it is not available, infant formulas are important because, in addition to their nutritional role, they also achieve a prebiotic effect in the body. The goal of this paper was to provide an overview of our research and application of potential prebiotics. Methods: The methodology was based on the analysis and synthesis of collected and systematized data and research results. Results: Supplementation with inulin, GOS and FOS is very important in the nutrition and development of infants, which was also shown during our clinical research of infant formulas supplemented with these prebiotics, where the bifidogenic effect was pronounced in the feces of infants fed with prebiotic infant formula. Human milk provides unique prebiotics, the effect of which is difficult to replicate. In vitro testing of some microbiologically synthesized potential prebiotics such as levan, pullulan, and beta-glucan, which is the first step in the analysis of potential prebiotics, showed a positive effect on individual probiotic strains or on a consortium of microorganisms isolated from infant feces. Determination of biochemical parameters and gas production are further criteria for the selection of potential prebiotics. Discussion: Our research indicates that there are different effects of prebiotics on selected individual probiotics or cultures from feces, which can be further tested in vitro and in vivo and then potentially applied in nutrition and supplementation.

Keywords: prebiotic; nutrition; inulin; levan

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The Separate and Combined Associations of Physical Activity and Diet Quality and Their Changes over Time with Mortality: Findings from the EPIC-Norfolk Prospective Cohort Study [†]

Shayan Aryannezhad ^{*} , Alexander Mok, Fumiaki Imamura, Soren Brage and Nita G. Forouhi



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and Objectives: Both physical activity and diet quality are associated with longevity, but less is known about their combined associations, especially in consideration of their changes over time. We aimed to examine the separate and combined associations of physical activity and adherence to a Mediterranean-type diet and their changes over time with mortality outcomes. Methods: The participants included 9349 adults aged 40 to 79 years old from the European Prospective Investigation into Cancer in Norfolk (EPIC-Norfolk) cohort, with repeated questionnaire-based measurements of physical activity and diet from 1993 to 2004. From the questionnaire responses, we derived physical activity energy expenditure (PAEE) and adherence to the Mediterranean Diet

Score (MDS) and calculated their average within-person changes (Δ PAEE and Δ MDS, respectively).

A multivariable-adjusted Cox regression was fitted to examine associations between PAEE and MDS at baseline, Δ PAEE, and Δ MDS and their combination with all-cause mortality, cardiovascular disease mortality, and cancer mortality up to March 2022. Results: For over 149,681 person-years of follow-up, there were 3534 deaths in the cohort. In the models mutually adjusted for potential time varying and static cofounders, for each 1-SD difference in baseline PAEE (4.64 kJ/kg/day), Δ PAEE (0.65 kJ/kg/day per year), baseline MDS (1.30 points), and Δ MDS (0.32 points per year), the hazard ratios (95% CI) for all-cause mortality were 0.90 (0.86 to 0.94), 0.89 (0.85 to 0.93), 0.95 (0.91 to 0.99), and 0.93 (0.90 to 0.97), respectively. Similar results were observed for cardiovascular disease mortality and cancer mortality. Among participants recording low PAEE (<5 kJ/kg/day) and low MDS (<8.5 points) at baseline, all-cause mortality was lower by 40% (18% to 56%) for those who improved both behaviours over time (recording high PAEE and high MDS), compared to those who remained to be low for both behaviours. During the follow-up, 461 potential deaths were prevented by adherence to high diet quality and high physical activity levels over the repeated assessments. Discussion: these findings suggest that improvements in physical activity levels and diet quality over time could lower mortality in middle-aged adults, and public health benefits could be realised by encouraging active living and healthy eating throughout adulthood.

Keywords: Mediterranean Diet; physical activity; mortality

Author Contributions: The current study was conceived and designed by S.A., A.M., S.B., F.I. and N.G.F.; data analysis and the first draft of the manuscript were completed by S.A. and supervised by S.B. and N.G.F.; all authors revised the manuscript critically for intellectual content, gave final approval of the version to be published and have contributed to the manuscript; S.A., S.B. and N.G.F. are the guarantors of this work and had full access to all the data in the study and took responsibility for the integrity of the data and the accuracy of the data analysis. The corresponding author attests

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Research UK (C864/A14136). We acknowledge funding support from the MRC Epidemiology Unit to N.G.F. and F.I. (MC_UU_00006/3) and S.B. (MC_UU_00006/4). N.G.F. and S.B. acknowledge support from the National Institute of Health and Care Research (NIHR) Cambridge Biomedical Research Centre (NIHR203312). N.G.F. is an NIHR Senior Investigator. The views expressed are those of the author(s) and not necessarily those of the NIHR or the Department of Health and Social Care. S.A. was funded by a UKRI MRC Studentship.

Institutional Review Board Statement: The study was approved by the Norfolk District Health Authority Ethics Committee and adhered to the Declaration of Helsinki.

Informed Consent Statement: All participants gave written informed consent before enrolment in the study.

Data Availability Statement: The data cannot be made openly available because of ethical and legal considerations. Non-identifiable data can be made available to bona-fide researchers on submission of a reasonable request to datasharing@mrc-epid.cam.ac.uk. The principles and processes for accessing and sharing data are outlined in the MRC Epidemiology Unit Data Access & Data Sharing Policy.

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Dietary Intake of Female Aesthetic Athletes [†]

Heather Galea *  and Petra Jones 



Citation: Galea, H.; Jones, P. Dietary Intake of Female Aesthetic Athletes.

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Dancers are considered aesthetic athletes due to the great emphasis directed towards maintaining svelte figures with the aim of

enhancing the aesthetic of performance. Ballerinas are consistently found 10–12% below their ideal body weight and are susceptible to the female athlete triad. Still, while the dietary intake of several sports populations has been extensively studied worldwide, in the dance arts data are limited. The aim of this study was to assess the dietary intake of adult female dancers on a small Mediterranean island. All dance schools in Gozo ($n = 7$) were invited to participate via email. A 4 day food and beverage diary recorded between Thursday and Sunday was used to assess the dietary intake of eligible students and teachers of dance schools. A self-reported questionnaire was used to assess demographic data and exercise energy expenditure, adapted from the ‘International Physical Activity Questionnaire’. Participants’ energy and macronutrient intakes were compared to the recommended dietary allowances (RDA) using the one sample t -test. The paired samples t -test was used to determine any significant differences in dietary intake between weekdays and the weekend. Of a potential 25 eligible participants, 14 engaged in the study yielding a 56% response rate. The majority of participants were recreational dancers ($n = 11$). The mean energy intake was 1306 kcal/day with 34.7% derived from fat. The mean carbohydrate and protein intakes were 2.4 g/kg bodyweight and 1.1 g/kg bodyweight, respectively. The mean total energy expenditure was 2034 kcal/day. The daily mean energy, carbohydrate and protein intakes were lower than the RDA, while mean fat intake was higher. There was no evidence of a significant difference in dietary intake between weekdays and the weekend ($p = 0.309$ carbohydrates, $p = 0.596$ fat, $p = 0.956$ protein). Professional dancers failed to meet energy, carbohydrates and protein recommendations for athletic populations, whereas, recreational dancers were likely to consume sufficient energy, carbohydrate and protein intakes. Dietary fat recommendations were met by half of the participants and exceeded by the rest. This study was the first to assess the dietary intake of a dance population in the Maltese Islands. Further research in a larger cohort of local dancers is merited.

Keywords: dietary intake; dancers; aesthetic athletes; Mediterranean

Author Contributions: Conceptualization, H.G. and P.J.; methodology, H.G. and P.J.; formal analysis H.G.; investigation, H.G.; data curation, H.G.; writing—original draft preparation, H.G.; writing—review and editing, P.J.; supervision, P.J. All authors have read and agreed to the published version of the manuscript.

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A Scoping Review on the Serum Biomarkers of Osteosarcopenic Obesity [†]

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Abstract: Background and objectives: Osteosarcopenic obesity/adiposity (OSO/OSA) syndrome describes the concurrent deterioration of bone, muscle, and adipose tissue. The objective of this review was to evaluate human studies addressing serum biomarkers in relation to OSA. Methods: A search in the PubMed, Scopus, and Web of Science databases was conducted to examine relevant articles published from their inception to the end of March 2023, using the MeSH strings in the search strategy. Only studies published in English and conducted in humans (≥ 18 years) without chronic diseases

(cancers, kidney/liver disease) or pregnancy were used. Book chapters, abstracts only, and studies in which participants did not have all three body composition components measured to identify OSA or in which the body composition components could not be related to the independent/exposure variables were excluded. Results: A total of $n = 943$ articles were retrieved from all three databases. After removing duplicates and articles unrelated to the topic, only $n = 4$ studies conducted in South Korea and China met the inclusion criteria. Three studies were cross-sectional while one was retrospective. Of the biomarkers, only serum 25(OH)D and ferritin were studied, showing strong relations with OSA. Discussion: Overall, lower serum vitamin D (< 20 ng/mL) and higher serum ferritin were associated with a higher prevalence of OSA. Further research is needed to develop biomarkers for each tissue that, in combination, may indicate the existing impairments and presence of OSA.

Keywords: osteosarcopenic adiposity; osteosarcopenic obesity; OSA; biomarkers



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Exploration of Perceptions and Attitudes of Couples in the Preconception Period in Relation to Healthy Eating and Healthy Body Weight: A Qualitative Study [†]

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Keywords: preconception period; educational tool; healthy diet

Evidence suggests that parental overweight/obesity during the preconception period, which can be a year before conception [1], may adversely affect offsprings' metabolic health in later life [2]. This study aimed to explore couples' perceptions toward healthy eating and lifestyles in the preconception period, which can help inform the development of targeted interventions. Eight pregnancy-planning couples were recruited using purposive–snowballing sampling and participated in a semi-structured online interview. Recordings were anonymised, transcribed verbatim, and analysed using phenomenological thematic analysis [3]. Couples' mean overall age was 34.3 years, and BMI was 26.8 kg/m², while the majority held a postgraduate degree (n = 9). Data analysis revealed seven themes: mental health matters; lifestyle behaviours that could change; physical health matters; establishing healthier habits; all things diet; preconception knowledge; and need for guidance. Data indicated limited preconception knowledge, particularly evident in men. During our interview, most men realised that men's preconception period can be important, indicating a lack of knowledge, and expressed interest in learning more: “. . . I would be happy also to ask for a professional advice, I'm just not sure if I would before this interview-if I would consider it necessary, now I do to be honest. . .”. The main motivators for making any dietary or lifestyle changes were to support maternal health, offer the “best start” to their child, and ensure they did the best they could to support a pregnancy. Most participants looked for information online when unsure and would welcome an online educational tool with opportunities to ask questions. Many explained that it is important to avoid information overload, while a few explained they did not look for information at all. Stress was a significant factor affecting efforts to implement changes (diet, smoking, body weight, sleep, exercise) and was one of the main behaviours that participants wanted to manage. Based on the results of this study, there is a paucity of knowledge around men's preconception health. An online interactive education tool could support couples in the preconception period to achieve healthier habits.

Author Contributions: Conceptualization, E.-I.A., F.T. and J.W.; methodology, E.-I.A., F.T. and J.W.; formal analysis, E.-I.A.; investigation, E.-I.A.; data curation, E.-I.A.; writing—original draft preparation, E.-I.A.;

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Salty Taste Perception in the Elderly Is an Important Determinant of Sodium Intake [†]

Irena Keser ^{1,*} , Helena Tomic'-Obrdaj ² , Jasmina Ranilovic' ² and Davorka Gajari ²



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Abstract: Background and objectives: Chemosensory function declines with the progression of age and can potentially impact adherence to a healthy diet. A loss of taste perception could induce higher sodium intake and increase the risk of cardiovascular diseases. The aim of this study was to determine whether there is a decrease in olfactory and gustatory function and to analyze the possible association with nutritional status and dietary sodium intake in older nursing home residents. Methods: This study included 123 participants aged 65 years and older (average age of 80.7 ± 5.8 years, 76.5% females) and 70 adults aged 18–64 years (average age of 43.8 ± 8.1 years, 77.2% females) for a comparison of chemosensory function. Olfactory function was determined by the European Test of Olfactory Capabilities (ETOC) and salty taste perception by the rapid detection threshold method. Nutritional status was evaluated by the Mini Nutritional Assessment-Short Form (MNA-SF[®]). Sodium intake was determined by 24 h recall collected on two non-consecutive days. Results: The results show that olfactory function in the elderly participants (17.3 ± 8.8 , 65% hyposmic) was significantly impaired compared to that in the younger population (29.3 ± 2.9 , 15% hyposmic) ($p < 0.0001$). The salty taste recognition threshold in the elderly population (48.8 ± 30.1) was significantly higher compared to that in the younger population (13.7 ± 10.7) ($p < 0.001$). The MNA[®] result for elderly participants was, on average, 13.7 ± 10.7 , which indicated normal nutritional status; 22.8% of participants were at risk of malnutrition; and 1.6% were malnourished. This study established significant association between a higher salty taste threshold and intake of sodium ($p < 0.02$), but there was no significant impact of the loss of olfactory perception on sodium intake. There was no significant association between the loss of gustatory or olfactory function and the nutritional status of elderly people. Discussion: This study showed that chemosensory function declines in older nursing home residents and nutritional status does not appear to be related to this, but it could have a potentially negative impact on health as it is associated with higher sodium intake. **Keywords:** elderly people; chemosensory function; nutritional status; sodium intake

Author Contributions: Conceptualization, H.T.-O.; methodology, H.T.-O.; software, H.T.-O.; validation, H.T.-O., I.K. and J.R.; formal analysis, H.T.-O.; investigation, H.T.-O.; resources, J.R. and D.G.; data curation, H.T.-O.; writing—original draft preparation, H.T.-O.; writing—review and editing, I.K., J.R. and D.G.; visualization, H.T.-O.; supervision, I.K. and J.R. All authors have read and agreed to the published version of the manuscript.

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Salty Taste Perception in the Elderly Is an Important Determinant of Sodium Intake [†]

Irena Keser ^{1,*} , Helena Tomic'-Obrdaj ² , Jasmina Ranilovic' ² and Davorka Gajari ²



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Abstract: Background and objectives: Chemosensory function declines with the progression of age and can potentially impact adherence to a healthy diet. A loss of taste perception could induce higher sodium intake and increase the risk of cardiovascular diseases. The aim of this study was to determine whether there is a decrease in olfactory and gustatory function and to analyze the possible association with nutritional status and dietary sodium intake in older nursing home residents. Methods: This study included 123 participants aged 65 years and older (average age of 80.7 ± 5.8 years, 76.5% females) and 70 adults aged 18–64 years (average age of 43.8 ± 8.1 years, 77.2% females) for a comparison of chemosensory function. Olfactory function was determined by the European Test of Olfactory Capabilities (ETOC) and salty taste perception by the rapid detection threshold method. Nutritional status was evaluated by the Mini Nutritional Assessment-Short Form (MNA-SF[®]). Sodium intake was determined by 24 h recall collected on two non-consecutive days. Results: The results show that olfactory function in the elderly participants (17.3 ± 8.8 , 65% hyposmic) was significantly impaired compared to that in the younger population (29.3 ± 2.9 , 15% hyposmic) ($p < 0.0001$). The salty taste recognition threshold in the elderly population (48.8 ± 30.1) was significantly higher compared to that in the younger population (13.7 ± 10.7) ($p < 0.001$). The MNA[®] result for elderly participants was, on average, 13.7 ± 10.7 , which indicated normal nutritional status; 22.8% of participants were at risk of malnutrition; and 1.6% were malnourished. This study established significant association between a higher salty taste threshold and intake of sodium ($p < 0.02$), but there was no significant impact of the loss of olfactory perception on sodium intake. There was no significant association between the loss of gustatory or olfactory function and the nutritional status of elderly people. Discussion: This study showed that chemosensory function declines in older nursing home residents and nutritional status does not appear to be related to this, but it could have a potentially negative impact on health as it is associated with higher sodium intake. **Keywords:** elderly people; chemosensory function; nutritional status; sodium intake

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Self-Perceived Parental Dietary Behavior Relates to Diet Quality and Weight Status of Children [†]

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Abstract: Background: Parents' own dietary habits have an impact on the diet quality and health of their children. Yet, the relationship between parental self-perceived health consciousness and health in preschool-aged children is not known. Thus, the aim was to study the relation of self-perceived dietary behavior of parents with their pre-school aged children's dietary quality and body adiposity. Methods: Parents of 2–6-year-old children (n = 738) were recruited from child health clinics across Finland. Parents were divided into health-conscious (HC, n = 396) and nonhealth-conscious (non-HC, n = 342) according to a self-perceived report of following a healthy diet. Semi-structured questionnaires on parental views on their child's diet were collected. Children's diet quality was evaluated with the Children's Index of Diet Quality (CIDQ). Anthropometrics of the children were recorded during the child's health clinic visit. BMI was converted to a BMI standard deviation score (BMI-SDS) and categorized according to the Finnish growth reference curves as well as the categories of the International Task Force (IOTF). Results: Children of HC parents had better diet quality compared to children of non-HC parents (11.4 ± 2.6 vs. 10.6 ± 2.6 , $p = 0.01$). They also presented lower BMI-SDS values compared to children of non-HC parents (-0.02 ± 1.12 vs. 0.19 ± 1.09 , $p = 0.015$). Categories of BMI-SDS according to the Finnish growth charts did not differ between the children of HC and non-HC parents. Yet, the categories of BMI-SDS according to cut-offs defined by the IOTF differed significantly between the HC and non-HC parents: the number of children with underweight was 44 (13.6%), normal weight 233 (72.1%), overweight 30 (9.3%) and obese 16 (5.0%), while the number of children of HC parents who were underweight was 69 (18.6%), normal weight 255 (68.7%), overweight 44 (11.9%) and obese 3 (0.8%). Conclusion: Parental self-perceived health consciousness in terms of healthy eating is related to adiposity and diet quality in children. Self-perceived healthy eating in parents could be one factor to consider when monitoring a child's health in health clinics.

Keywords: diet behaviour; diet quality; obesity; children

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Is Taurine Concentration in Urine a Significant Indicator of Fish Consumption among Polish Postmenopausal Women? Data from a Pilot Study [†]

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Abstract: Background and Objectives: Taurine is a marker of fish and seafood intake. It is also suggested that its increased excretion in the urine is inversely associated with mortality from cardiovascular diseases. This study aimed to assess taurine concentration in Polish postmenopausal women's urine and whether higher urinary taurine excretion is associated with higher fish intake in the aimed population. Methods: Thirty-three postmenopausal women, with an average BMI of 26.7 kg/m², were asked for three days to record their dietary information concerning fish (including shellfish) intake, and twenty-four-hour urinary taurine excretion was measured using the high-performance liquid chromatography (HPLC) method. Anthropometric parameters were also evaluated. All data are presented as mean ± standard error of the mean. Results: The study population was divided into two groups according to the median taurine/creatinine ratio (Tau/Cr), with the cut-off value of 46.8 µmol/mmol. A significantly lower ($p < 0001$) concentration of taurine in the 24 h urine samples was observed in the group with a low Tau/Cr ratio (231.3 ± 35.5 µmol/day) in comparison to the high Tau/Cr ratio group (612.7 ± 48.8 µmol/day). Postmenopausal women with a higher Tau/Cr ratio daily consumed more fish (60.2 ± 11.9 g) and eggs (25.0 ± 4.5 g) compared to the group with a low Tau/Cr ratio (16.2 ± 5.3 g vs. 11.1 ± 4.6 g, respectively). Discussion: higher 24 h urinary Tau/Cr ratio can be related to higher fish intake in Polish postmenopausal women.

Keywords: taurine; postmenopausal women; fish intake

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CHANGE: A Multi-Country Cohort Project Exploring Child Malnutrition and Adult Non-Communicable Disease: Generating Evidence on Mechanistic Links to Inform Future Policy/Practice [†]

Kimberley McKenzie ¹, Natasha Lelijveld ², Debbie Thompson ¹, Kenneth Anujoo ², Mubarek Abera ³ and Marko Kerac ^{2,*}  on behalf of the CHANGE Study Collaborators Group



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CHANGE: A Multi-Country Cohort Project Exploring Child Malnutrition and Adult Non-Communicable Disease: Generating Evidence on Mechanistic Links to Inform Future Policy/Practice. *Proceedings* **2023**, *91*, 117. <https://doi.org/10.3390/proceedings2023091117>

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Abstract: Background and rationale: Child malnutrition is a major global public health problem highlighted by Sustainable Development Goal 2 (“End hunger”). Whilst current malnutrition treatment programmes in humanitarian and low/middle-income country settings focus on the rapid recovery of weight and fast post-malnutrition growth, evidence from small infants in high-income settings suggests that too fast catch-up growth has a risk of later-life non-communicable disease (NCD). We thus aim to improve severe malnutrition treatment programmes by better understanding the links between infant/child undernutrition and longer-term (adult) cardiometabolic NCD. Our objectives are as follows: 1. explore different patterns of post-malnutrition weight gain/growth; 2. investigate the associations between weight gain/growth during and after malnutrition and NCD risk profile as assessed by adults/in later life; 3. understand how the following may influence the risk of later-life NCD: a. the timing of the malnutrition, b. the severity of malnutrition, and c. different patient management approaches (NB., Jamaica used inpatient-only management; Malawi was hybrid; Ethiopia used outpatient-only care). Methods: We will use already collected data from three cohorts of survivors of child malnutrition: Jamaica were originally treated for malnutrition in 1960–95; Malawi was originally treated in 2006–7; Ethiopia was originally treated in 2014–15 We will carry out the following steps: 1. pool data from our three cohorts, identifying and grouping common variables; 2. generate new exposure variables of “post-malnutrition growth” (since there is no one standard definition of this, we will use six different alternatives defining growth in slightly different ways); 3. summarise NCD outcome variables already available in the datasets (e.g., BP, body composition, fasting glucose, and other blood markers of NCD risk); 4. use regression analysis to explore the association between early-life post-malnutrition growth and later-life NCD/NCD risk. We hypothesise that faster post-malnutrition growth is associated with greater NCD risk. Results: The preliminary results from Jamaica and Malawi suggest that for children who grew the fastest, post-malnutrition have associated cardiometabolic NCD risk later in life. Conclusions: Even though our cohorts are in low- and middle-income countries, there are lessons to be learned for other countries undergoing nutrition transition and disadvantaged/vulnerable populations in high-income countries.

Keywords: severe malnutrition; post malnutrition weight gain; non-communicable disease risk

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D.T., M.A., K.A. and M.K.; supervision, M.K. and D.T.; project administration, M.K.; funding acquisition, M.K. and D.T. All authors have read and agreed to the published version of the manuscript.

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Does Physical Activity Level Relate to Food Intake, Appetite, and Body Composition in Older Adults? [†]

Dilara Dericioglu ^{*}, Lisa Methven [†] and Miriam Clegg



Citation: Dericioglu, D.; Methven, L.; Clegg, M. Does Physical Activity Level Relate to Food Intake, Appetite, and Body Composition in Older Adults?

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body weight and muscle mass loss, which can affect their physical capabilities. Physical activity (PA) may be an effective strategy to promote appetite in older adults; however, current evidence is insufficient to support recommendations. The objective of this study was to investigate the relationship between PA levels and food intake, appetite, and body composition in 108 healthy older adults (49 males,

59 females; 70 (SD 4) years; body mass index (BMI) 24.3 (SD 2.6) kg/m²). Following data collection, participants were categorised into tertiles (low, medium, high) based on PA level measured using a wrist-worn accelerometer, and on activity energy expenditure (AEE) and total energy expenditure (TEE) assessed through simplified PA diaries recorded for seven consecutive days. Body composition was evaluated using a bioelectrical impedance monitor, energy and nutrient intake using 3-day weighed food diaries, and appetite via the Council on Nutrition Appetite Questionnaire (CNAQ) and 100 mm visual analogue scales used at 30 min intervals over a single day. Weight and BMI were significantly higher in the high-AEE and -TEE groups than the low and medium groups ($p < 0.05$), while percentage fat mass was significantly greater in the high-AEE and -TEE groups compared to low groups ($p < 0.05$). There was a trend towards higher energy intake in the high-TEE group compared to the low group ($p = 0.084$). Protein intake was significantly higher in the high-AEE and -TEE groups compared to the low groups ($p < 0.05$), whereas fibre intake was significantly higher in the high-PA group than the low group ($p = 0.035$). Although there were no significant differences in appetite from the CNAQ data, the high-PA group had a higher total area under the curve (0–720 min) for desire to eat food compared to the low-PA group ($p = 0.036$). This work builds a foundation for intervention studies required to examine whether PA and exercise affect appetite and food intake in older adults.

Keywords: older adults; appetite; physical activity; body composition; energy intake

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Abstract: With ageing, older adults' (≥65 years) appetite and desire to eat decrease, causing

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Ten Hour Time-Restricted Eating (TRE) Is Associated with Improvements in Energy, Mood, Hunger and Weight in Free-Living Settings: The ZOE BIG IF Study [†]

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Abstract: Background and objectives: TRE is an intermittent fasting (IF) technique adopted for its flexibility, which focuses on the timing of eating rather than on the quantity or quality of caloric intake. Tightly controlled metabolic studies show the beneficial health effects of TRE; however, the impact of TRE in free-living settings is unknown. A community experiment on 148,374 people aimed to explore acceptability, and changes in weight, energy, mood and hunger with TRE. Methods: The BIG IF study (NCT05558423) was carried out using the ZOE Health Study smartphone app. UK users completed a baseline habitual eating phase (1 week) followed by an intervention TRE phase (2 weeks) (eating window (EW) of ≤ 10 h), with additional IF weeks optional. Users self-reported their weight pre- and post-intervention and logged EW, energy, mood, and hunger daily. A subgroup of engaged users included those who regularly logged and completed questionnaires pre and postintervention. Mixed-effects growth models examined changes in health metrics over time. Results: Of 246,000 active ZHS users, 148,374 users signed up, 37,545 completed the core intervention period (3 weeks), 36,231 opted for additional weeks, and 27,371 were classified as highly engaged. Of engaged users ($n = 27,317$), 78% of the participants were female, with a mean (\pm SD) age of 60 (10) years, BMI of 25.6 (3.02) and baseline EW of 11.3 h (95% CI: 11.2–11.4). Overall, 51% of engaged users reported a small reduction in weight over 2–16 weeks (mean change -1.09 kg (IQR: $-0.8, -1.4$), which was greater in those with larger EW changes (Q1 0.90 h; -1.07 ± 0.01 kg vs. Q4 3.18 h; -1.14 ± 0.01 kg). Practising TRE over a longer duration was associated with higher reported energy (time x EW coefficient (β): 0.016 ± 0.02), mood (β : 0.008 ± 0.02) and lower hunger (β : -0.016 ± 0.02) ($p < 0.01$ for all). Interestingly, inconsistencies in EWs were associated with lower energy, mood and higher hunger. Conclusion: In this study, 60% of users were prepared to try TRE, which improved their self-reported health in real-world life conditions. People wanting to practise TRE may benefit more if their EW is long at baseline and should consider consistency and the duration of time required to observe effects.

Keywords: intermittent fasting; eating window; time restricted eating



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Nutritional Status and Eating Behaviors of Athletes with Eating Disorders [†]

Marija Andjelkovic ^{1,*} , Nenad Dikic ¹ , Tamara Stojmenovic ¹, Ivan Nikolic ², Vera Blazencic Mladenovic ³ and Jelena Bekic ⁴

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Abstract: Introduction and Purpose: Athletes, especially in weight-dependent sports, are at higher risk of developing eating disorders (ED). Relative Energy Deficiency in Sport (RED-S) results from a mismatch between energy intake (EI) and exercise, leading to an athlete triad. Material and Methods: Our study includes ten high-performance athletes who came to the Center for Sports Nutrition and Supplementation because of ED. Nutritional and mental status were evaluated individually (physician's examination, body composition, eating and supplement habits, blood analysis, accelerometer, and three-day diet diary). Results: Nine female and one male athlete with an average age of 17 years are classified as having anorexia nervosa (5), bulimia nervosa (4), or an eating disorder not otherwise specified (1). Female athletes had an average BMI of 18.4 kg/m² and an F% of 19.7. All athletes had RED-S with an average EI of 1660 kcal/day and an energy expenditure of 2300 kcal/day. Representing different sports (swimming, volleyball, tennis, basketball, jazz ballet, and synchronized swimming), 7/10 athletes stopped training and 5/10 needed hospitalization because of ED exacerbation. In 7/9 athletes, there were <6 menses/12 months. An antidepressive drug (SSRIs) was indicated in six athletes. The average serum iron level was low, at 13.5 micromol/L. Carbohydrates, fat, and proteins were present in EI at 42.8%, 35.4%, and 21.8%. Athletes showed an intake deficit of cholesterol, magnesium, biotin, chrome, iron, fiber, folate, iodine, potassium, vitamins D, E, and K, pantothenic acid, and pyridoxine. Conclusion: Early identification of ED is associated with better outcomes. Educating athletes, sports entourages, and especially parents about healthy eating, pathological eating behaviors, and their consequences is crucial.

Keywords: nutrition; eating disorder; athletes



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Current Trends in Eating Habits of Serbian Adolescents—Data from a Health Behaviour in School-Aged Children Study in Serbia [†]

Jelena Gudelj Rakic ^{*} , Biljana Kilibarda, Milena Vasic  and Verica Jovanovic



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Abstract: Background and aim: Adolescence is a nutritionally vulnerable life phase. Poor eating habits formed during adolescence can lead to obesity and diet-related diseases in later years. The adoption of healthy eating habits is of particular importance, not only because of the direct impact on growth and development at this age, but also because of the impact on health in adulthood. A change in dietary habits in adolescence is marked by a higher intake of soft drinks, sweets, and salty snacks, with a decrease in the intake of vegetables, fruits, and milk and dairy products. The aim of this study was to show current trends in the eating habits of Serbian adolescents. Method: This study comprised a secondary analysis of data collected from 11–15-year-old students who participated in two cross-sectional Health Behaviour in School-aged Children Surveys (HBSC), conducted in Serbia in 2018 and 2022. Data on breakfast consumption and the intake of fruit, vegetables, soft drinks, and sweets were analyzed. Results: About two thirds of students (67.7%) in 2022 were eating breakfast every day during the working week, significantly more than in 2018 (58.8%), with no gender differences. The number of students who never eat breakfast during the working week is increasing (7.5% in 2018, 9.9% in 2022), with the highest numbers in the oldest age group. When it comes to the intake of fruit and vegetables, students do not meet the recommendations: in 2022, less than half of the students consumed fruit and vegetables once a day or more (39.6% fruit, 39.7% vegetables), while the frequency of a daily intake of fruits and vegetables decreased with age. The results show a decrease in daily consumption in comparison to 2018. Less than one fifth of students in 2022 consumed soft drinks daily (18.8%), boys more often than girls (21.5% vs. 16.4%), significantly less than in 2018 (22.4%). The consumption of soft drinks increases with age. More than a third of adolescents in 2022 ate sweets once a day or more often (34.8%), girls more often than boys (38.7% vs. 30.3%). This consumption has not changed since 2018. Conclusions: The findings of this study indicate a need for a more intensive nutrition-related health education of adolescents in order to improve their eating habits.

Keywords: adolescents; eating habits; Serbia

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Early Pregnancy Folic Acid Supplement Use and Folate Status in the Alberta Pregnancy Outcomes and Nutrition (APrON) Study [†]

Amy Tan ¹, Maria F. Mujica-Coopman ², Nicole Letourneau ^{3,4} , Deborah Dewey ⁴ , Gerald Giesbrecht ⁴, Catherine Field ⁵ and Yvonne Lamers ^{1,*} 



Citation: Tan, A.; Mujica-Coopman, M.F.; Letourneau, N.; Dewey, D.; Giesbrecht, G.; Field, C.; Lamers, Y. Early Pregnancy Folic Acid Supplement Use and Folate Status in the Alberta Pregnancy Outcomes and Nutrition (APrON) Study. *Proceedings* 2023, 91, 100. <https://doi.org/10.3390/proceedings2023091100>

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Abstract: Background and Objective: Periconceptional supplementation with 400 µg/day of folic acid (FA) is recommended for primary prevention of neural tube defects, such as spina bifida. In Canada, where higher-dose prenatal FA supplement use is highly prevalent, there is increasing concern over possible excess maternal FA supplementation. The objective of this study was to assess the association between prenatal FA supplementation and circulating folate forms at <20 gestational weeks (GW) in Canada. Methods: For the EpiBrain Project, a transnational collaboration investigating B-vitamin-related early programming of neurodevelopment, we used data on a subsample of apparently healthy, non-fasting pregnant women from the Alberta Pregnancy Outcomes and Nutrition (APrON) Study (n = 250P). Self-reported FA supplement intake was assessed using a questionnaire. Plasma folate, red blood cell (RBC) folate, and plasma total homocysteine (tHcy) concentrations were measured using LC-MS/MS, and plasma total vitamin B12 (tB12) concentration was measured using an immunoassay. Descriptive statistics are presented as medians (25th percentile and 75th percentile). Results: The median maternal age was 31 (28, 33) years. At 15.4 (13.4, 17.4) GW, the RBC total folate, plasma total folate, and plasma tB12 and tHcy concentrations were 1333 (1027, 1652) nM, 49 (40, 61) nM, 247 (184, 321) pM, and 4.5 (3.8, 5.4) µM, respectively. Most participants reported FA supplement use of 1000 µg/day (45%); about 23% reported >1000 µg/day, 21% reported 400–<1000 µg/day, 8% reported <400 µg/day, and 3% presented no data. FA supplement dose was correlated (Bonferroni-adjusted $p < 0.05$) with plasma and RBC total folate (Spearman's $\rho = 0.26$ and 0.28 , respectively), plasma and RBC 5-methyltetrahydrofolate ($\rho = 0.20$ and 0.24 , respectively), and plasma unmetabolized FA ($\rho = 0.21$). RBC total folate concentration differed among the supplement groups (Kruskal–Wallis test, $p < 0.05$) and was higher in those supplementing with >1000 µg/day (1259 (885, 18,444) nM; Dunn's test, $p < 0.05$) compared to the lower-dose groups. FA supplement dose was not associated with the contribution of each RBC or plasma folate form to total folate. Discussion: These preliminary findings from the APrON cohort indicate that FA supplement use at <20 GW is associated with circulating folate forms. These findings will be compared with data from pregnancy studies in Northern Ireland and Spain for the EpiBrain Project. The EpiBrain Project will provide evidence that can inform health policies and recommendations regarding the use of folate and other B vitamin supplementation during pregnancy.

Keywords: pregnancy; folic acid; supplements; folate; biomarkers

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Public Procurement for School Meal Programmes in Sub-Saharan Africa: Nutritional Outcomes, Implementation Challenges and Programme Enablers [†]

Julia Liguori ^{1,*}, Hibbah Araba Osei-Kwasi ², Mathilde Savy ¹, Silver Nanema ³, Amos Laar ³ and Michelle Holdsworth ¹



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Abstract: Background and Objectives: School-focused public food procurement and service policies (SPFPs) are increasingly being recognised as interventions that can improve the nutritional quality of food served in schools amidst growing overweight/obesity and persistent micronutrient deficiencies, stunting and wasting in sub-Saharan Africa (SSA). The review aims to investigate the impact of such policies on school food environments and nutritional outcomes of children/adolescents (5–18 y) in SSA and explore challenges and facilitators to implementing effective procurement. Methods: A mixed methods systematic review of studies in SSA published between 2012 and February 2023 was conducted. Studies were included if they reported on a publicly funded school meal (e.g., breakfast, lunch, snack, take home ration) and a nutritional (anthropometric, micronutrient deficiencies, food consumed) or food environment outcome. Quantitative findings were synthesised descriptively. Qualitative evidence was synthesized using an adapted eight-step school food system framework to guide coding (food production, wholesale & trading, transportation & storage, processing & distribution, food preparation, distribution to students, student-stakeholders and community involvement). This framework, along with infrastructure support domains, namely leadership, governance and monitoring/evaluation, guided categorisation of authors' policy-related recommendations. Results: A total of 33 studies (26 qualitative, 7 quantitative) were included from nine SSA countries. Evidence from the quantitative studies was mixed and did not demonstrate any measurable impact of SPFPs on nutritional outcomes. In total, 53 implementation challenges, particularly in food distribution, food preparation and wholesale & trading, and 37 implementation facilitators, notably student stakeholders, community involvement and processing & distribution, were identified across the school food system. Infrastructure support and policy recommendations from authors span across the school food system, particularly for improving food preparation and engaging students in programming. Discussion: While little evidence on the impact of publicly funded school meal programmes and nutrition outcomes was found (partly explained by inadequate research design to evaluate impact), qualitative evidence suggests that developing or revising SPFPs to include healthy (nutritious and safe) food at all levels of the school food system has much potential. The array of policy action needed to improve implementation of school meal programmes across the school food system calls for action at multiple scales of governance (national/local government), as well as engaging schools and local communities to strengthen stakeholder involvement.

Keywords: school meal programme; public procurement; sub-Saharan Africa

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Low Iodine Status in a Large Pregnancy Cohort in Ireland [†]

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Keywords: maternal iodine status; urinary iodine concentration; pregnancy; sociodemographic determinants

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Background: Iodine is an essential component of the thyroid hormones thyroxine (T₄) and triiodothyronine (T₃), which are required for brain development. Urinary iodine concentrations (UIC) and iodine intakes in the most recent National Nutrition Survey highlighted a high prevalence of low iodine status among women of child-bearing age. There are no contemporary data on iodine intake or status during pregnancy in Ireland. **Aim:** This study aims to assess iodine status in a large cohort of women during pregnancy. **Methods:** Participants were nulliparous women participating in the Improved Pregnancy Outcomes by Early Detection (IMPROVED) cohort study (<http://www.clinicaltrials.gov>:

ID NCT01891240 (accessed on 8 November 2016) recruited at Cork University Maternity Hospital). Clinical and questionnaire-based assessments were carried out at 11, 15, 20, and 33 weeks of gestation. Urinary iodine concentration (UIC) at 11 and 15 weeks of gestation was quantified using the Sandell–Kolthoff (S–K) microplate colorimetric method. Statistical analysis was performed using IBM SPSS Version 28 (IBM Corp, Armonk, NY, USA). **Results:** The total sample was 1509 women having a low-risk, singleton pregnancy.

The median (IQR) age and BMI were 31 (5) years and 24.5 (5) kg/m², respectively. Notably, 93% were married or in a relationship; 89% were employed; 70% had a tertiary education; 69% had an annual combined household income above 42 k; and 67% were consuming an iodine-containing supplement. At the first study visit, 8% were still smoking, and 3% were consuming alcohol. Median (IQR) UIC at 11 and 15 weeks of gestation were 129 (122) and 125 (132) µg/L, respectively ($p = 0.819$), and 60% were below the WHO population threshold for iodine sufficiency during pregnancy (150 µg/L) at both timepoints. At 15 weeks of gestation, UIC was significantly higher in iodine-containing supplement users (67%) than non-users (134 (139) µg/L vs. 109 (110) µg/L, $p = 0.002$). Supplement use was the only statistically significant determinant of UIC at 15 weeks of gestation (β (95% CI): 24 (14, 34) µg/L) after adjustment for age, ethnicity, BMI, and employment status. This first large-scale investigation of maternal iodine status in Ireland shows that most women have insufficient iodine status during early pregnancy. Further analysis will consider the influence of this risk factor on offspring's neurological development.

Author Contributions: L.K., Y.O. and J.B. carried out the iodine analytical work. Á.H. and M.K. designed the statistical analysis plan. L.K. conducted the statistical analysis and wrote the manuscript. Á.H. and M.K. reviewed and edited the manuscript. All authors have read and agreed to the published version of the manuscript.

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Relationships between Parental Feeding Practices and Consumption of Vegetables and Fruits—The Perspective of Two Generations [†]

Marzena Jezewska-Zychowicz ^{*}, Aleksandra Małachowska ^{ID} and Zuzanna Siwiec



Citation: Jezewska-Zychowicz, M.; Małachowska, A.; Siwiec, Z. Relationships between Parental Feeding Practices and Consumption of Vegetables and Fruits—The Perspective of Two Generations. *Proceedings* 2023, 91, 30. <https://doi.org/10.3390/proceedings2023091030>

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Abstract: Background and objectives: Eating behaviors are formed during childhood; therefore, parental practices play an important role in shaping them. The objective of this study was to determine the association between mothers' childhood food experiences (CFE), parental feeding practices (PFP) towards their own children aged 4–10 years, and consumption of fruit and vegetables among children and mothers. Methods: A total of 260 women with at least one child aged 4–10 years participated in a cross-sectional study carried out in 2021–2022. The questionnaire consisted of questions from the Adults' Memories of Feeding in Childhood (AMOFiC) questionnaire and the Comprehensive Feeding Practices Questionnaire (CFPQ). They contain statements describing similar family situations and feeding practices, with responses ranging from never/disagree (1) to very often/agree (5). The AMOFiC includes the option "I don't remember". The consumption of fruit and vegetables was assessed based on the frequency of consumption and number of servings. Descriptive statistics, the Chi2 test, and the Pearson correlation coefficient were used in the statistical analyses. Results: Positive correlations between the frequency of eating and the intake of vegetables (0.532 and 0.485, respectively) and fruits (0.597 and 0.410, respectively) have been found in both mothers and children. Positive correlations were found between CFE and PFP, such as the use of weight control restrictions ($r = 0.527$) and modeling ($r = 0.230$), whereas monitoring practices and experiences were not correlated (0.098). Children's fruit and vegetable intake correlated positively with monitoring (0.396 and 0.287, respectively), modeling (0.278 and 0.286), and involvement (0.205 and 0.156). Their fruit and vegetable intake correlated negatively with food rewarding (-0.167 ; -0.317), whereas vegetable intake correlated with emotion regulation (-0.283). Mothers' fruit intake correlated positively with experiencing food restrictions only in childhood (0.229). Conclusions: Mothers' CFE may induce similar practices when raising their children, including restrictions to control child weight and modeling. PFP such as modeling, monitoring, and involvement promote higher consumption of fruit and vegetables in children; however, using food as a reward and emotion regulation was linked to lower intake. The relationship between mothers' CFE and PFP confirms the intergenerational transmission of parental food-related practices.

Keywords: food consumption; children; parental feeding practices; food experiences

Author Contributions: Conceptualization, M.J.-Z. and A.M.; methodology, M.J.-Z.; validation, M.J.-Z.; data curation, M.J.-Z. and Z.S.; writing—original draft preparation, review and editing, M.J.-Z. All authors have read and agreed to the published version of the manuscript.

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LC-MS-Based Metabolomics for Dietary Biomarker Discovery in a Cohort of Pregnant and Lactating Women and Their Infants[†]

Mia Stråvik^{1,*} , Olle Hartvigsson¹, Stefania Noerman¹ , Anna Sandin², Agnes E. Wold³, Malin Barman¹  and Ann-Sofie Sandberg¹ 



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Abstract: Circulating food metabolites could improve dietary assessment by complementing more traditional, subjective methods. However, information is lacking on the accuracy of these objective markers during pregnancy and lactation. The objective of this paper was to measure a panel of candidate food intake biomarkers, representing different food groups, during pregnancy, delivery, and lactation and correlate their plasma levels with self-reported food intake. All data was collected within the Swedish birth cohort Nutritional impact on Immunological maturation during Childhood in relation to the Environment (NICE). Plasma samples from the women (gestational week 29, N = 579; delivery, N = 532; and four months postpartum, N = 477) and their infants (delivery, N = 348; and four months, N = 193) were analyzed with untargeted liquid chromatography-mass spectrometry (LC-MS) based metabolomics. Food intake was assessed during pregnancy (gestational week 34) and lactation (one and four months postpartum) using a semi-quantitative food frequency questionnaire. Spearman correlation analyses with plasma levels and reported food intake were adjusted for multiple testing. Acetylcarnitine, choline, indole-3-lactic acid, lutein, pipercolic acid, proline betaine, and 3-carboxy-4-methyl-5-propyl-2-furan-propanoic acid (CMPF) were identified in plasma. Self-reported intake of fruit juice correlated positively with proline betaine during pregnancy ($\rho = 0.38$, $p_{\text{adj}} < 0.001$), delivery ($\rho = 0.23$, $p_{\text{adj}} < 0.001$), and postpartum ($\rho = 0.41$, $p_{\text{adj}} < 0.001$), and also with infant plasma levels at delivery ($\rho = 0.25$, $p_{\text{adj}} < 0.001$). Lutein correlated with vegetables in general, both during pregnancy ($\rho = 0.31$, $p_{\text{adj}} < 0.001$) and delivery ($\rho = 0.29$, $p_{\text{adj}} < 0.001$). CMPF in plasma from mothers and infants at four months correlated with maternal intake of fatty fish (mother: $\rho = 0.30$, $p_{\text{adj}} < 0.001$; breastfed infant: $\rho = 0.26$, $p_{\text{adj}} = 0.037$). No clear associations were obtained for the remaining metabolites. Our study confirms the use of proline betaine as a citrus fruit intake biomarker, primarily in the form of juice, for pregnant and lactating women. Plasma lutein could be useful as a more general fruit and vegetable intake biomarker during pregnancy, and CMPF as a fish intake biomarker during lactation. ClinicalTrials.gov identifier: NCT05809479

Keywords: dietary biomarkers; metabolomics; pregnancy; lactation; infants; lutein; proline betaine

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Data Availability Statement: The R-code for conducting the statistical analyses can be obtained from: <https://gitlab.com/miastravik/dietary-biomarkers>. The in-house developed R-based OCEAN Shiny app used for metabolite identification can be obtained from: <https://gitlab.com/parasitetwin/autoannotshiny>. Data described in the manuscript will not be made available because it relates to information that could compromise research participant privacy or consent. The food frequency questionnaires are not publicly available due to proprietary rights.

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Comparison of Vegan and Omnivorous Diets in Pregnant Women: First Results of the PREGGIE Study [†]

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Abstract: Objective: The interest in vegan nutrition and the number of vegans in Germany are increasing. Especially, young women decide to choose a vegan diet. However, there are concerns whether a vegan diet can ensure nutrient adequacy during pregnancy. Methods: The study investigated the energy and nutrient intake as well as food consumption of vegan (VN; n = 34) and omnivorous (OM; n = 16) pregnant women via a 3-day weighed dietary record at the beginning (week 9–16) and at the end (week 35–38) of pregnancy. Results: Significant differences between VN and OM were found in the intake of vitamin B12, niacin, vitamin K, vitamin C, potassium, magnesium, dietary fibre, salt, cholesterol, saturated, monounsaturated and polyunsaturated fatty acids (PUFA), α-linolenic acid, and linoleic acid at the beginning and end of pregnancy. For all nutrients assessed, the VN participants’ median intake met the harmonised average requirements. However, the VN median intakes (including supplements) did not reach the D-A-CH reference values for pantothenic acid, potassium, iron, and iodine at least at one time point. The OM participants’ median intake (including supplements) did not reach the D-A-CH reference values for vitamin D, potassium, calcium, iron, PUFA, eicosapentaenoic acid (EPA), as well as docosahexaenoic acid (DHA) at least at one time point. Excluding supplementation, both groups failed to reach the reference intakes for the following nutrients for both time periods: vitamin D, folate, iron, iodine, EPA, and DHA. In terms of mean intake (including supplementation), the VN group achieved the D-A-CH reference values for all critical nutrients in a VN pregnancy, except for iodine, while OM did not reach the reference intakes for calcium, iron, EPA, and DHA at one or both time points. Conclusion: Including appropriate supplementation, an adequate intake of critical nutrients appears to be possible in a VN diet during pregnancy.

Keywords: vegan diet; pregnancy; critical nutrients; energy intake; vitamins; minerals; fatty acids; supplements

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Low Maternal Iodine Status in Early Pregnancy Is Associated with Cognitive and Language Delays at 24 Months in Non-Users of Nutritional Supplements [†]

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Abstract: Background: Severe maternal iodine deficiency has profound consequences for the developing brain; however, the impact of mild to moderate deficiency is less clear, and findings from observational studies have been mixed. Aim: The purpose of this study is to assess the relationship between maternal iodine status in early pregnancy and infant neurological development in an Irish maternal–infant cohort. Methods: Maternal–infant dyads of the Improved Pregnancy Outcomes by Early Detection (IMPROVED) and the Cork Nutrition and Development (COMBINE) cohorts (*n* 456) were followed during pregnancy and from birth to 2 years of age. Participants completed detailed a clinical and questionnaire-based assessments (including Bayley's Scale of Infant Development (BSIDIII) at 24 months; *n* 295). Maternal urinary iodine concentration (UIC) was quantified at 15 weeks of gestation by the Sandell–Kolthoff (S-K) method, and urinary creatinine (Cr) was quantified by the Jaffe rate method using the RX Monaco Clinical Chemistry Analyser (Randox Laboratories Ltd.). Statistical analysis was performed using IBM SPSS Version 27 (IBM Corp., Armonk, NY, USA). Results: The median (IQR) maternal age at delivery was 32 (5) years, and the median (IQR) BMI at 15 weeks of gestation was 25.1 (5.0) kg/m². Three-quarters completed third-level education, 95% were in a relationship and 7% were smokers. Median (IQR) UIC was 118 (132) µg/L, and 65% had UIC < 150 µg/L. At 24 months, median (IQR) cognitive, language and motor composite scores were 105 (15), 103 (20) and 103 (14), respectively. Cognitive, language and motor developmental delay was indicated in 6.0, 7.8 and 0.4% of children, respectively. Though a slightly higher prevalence of developmental language delay was observed among infants of mothers with UI:Cr < 150 µg/g for language (11 versus 6%) and a combined cognitive/language outcome (10 versus 4%), when adjusted for education, marital status, gestational age and birthweight, UI:Cr was not associated with language delay (aOR (95% CI): 1.7 (0.6, 4.7)). Among non-users of iodine supplements (29% of sample; median (IQR) UIC: 84 (96) µg/L; 75% < 150 µg/L), for every 10 µg/L increase in UIC, we observed a 23% and 19% reduction in odds of cognitive and language delay, respectively (aOR (95% CI): 0.77 (0.71, 0.97), *p* = 0.029; 0.81 (0.66, 0.99), *p* = 0.035). Our findings highlight the importance of sufficient iodine status in early pregnancy.

Keywords: maternal iodine status; infant neurodevelopment; pregnancy



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Exclusive Breastfeeding Is Associated with Total Breastfeeding Duration and Growth Outcomes: Icelandic Mother and Child Health Study (ICE-MCH) [†]

Jenny Jonsdottir ^{1,2,*} , Birna Thorisdottir ^{1,2} and Inga Thorsdottir ^{1,2}



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[†] Presented at the 14th European Nutrition Conference FENS 2023,

Abstract: Introduction: Little is known about the association between the duration of exclusive breastfeeding (EBF) and total breastfeeding. More evidence is needed on the association between EBF and growth in whole birth cohorts. Aims: The aim of this study was to assess whether the duration of EBF is associated with total breastfeeding duration until 12 months of age. The association between EBF duration and weight and length was studied at 6, 8, 10, 12, and 48 months of age. Methods: Health-care registries were used to obtain breastfeeding and anthropometric data on all live-born children in Iceland between 1 January 2009 and 31 December 2014. Kaplan–Meier plots were conducted to assess the survival probability of total breastfeeding duration up to 12 months among infants who either received EBF or were partially breastfed at 3 months and at 5 months. For the same groups, T-tests and two-way analyses of variance, adjusted for sex, residence, birth weight, and birth length, were conducted to estimate differences in anthropometric outcomes from 6 months up to 4 years of age. Results: The total number of participants was 25,793. At 3 months, 59% received EBF and 26% were partially breastfed. At 5 months, 36% received EBF and 40% were partially breastfed. The survival probability for breastfeeding at 12 months was 47% among infants that received EBF for 3 months and 30% among infants that were partially breastfed for 3 months. Among infants that received EBF for 5 months, the survival probability at 12 months was 56%, while it was 37% among infants that were partially breastfed for 5 months. EBF infants were heavier and longer at birth and had a significantly slower growth rate up to 4 years of age, compared to non-EBF infants. Conclusions: A longer duration of EBF increases the likelihood for longer breastfeeding duration up to 12 months and is associated with slower growth up to 4 years. The size of the effect on growth was small and should be evaluated in light of the larger birth size of EBF infants, and former studies show the healthy growth of infants who received EBF for 6 months.

Keywords: infant; nutrition; growth; breastfeeding; birth cohort

Author Contributions: All authors contributed to the conceptualization; methodology; validation; investigation; data curation; and writing—original draft preparation, review and editing; visualization. I.T. and B.T. were responsible for resources; supervision; project administration; funding acquisition. J.J. did software work and formal analysis. All authors have read and agreed to the published version of the manuscript.

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Riboflavin Status in Pregnancy and Its Relationship with Blood Pressure, Heart Rate and Risk of Hypertension: Findings from the OptiPREG Observational Study [†]

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Abstract: Clinical riboflavin deficiency is common in low- and middle-income countries, whilst suboptimal riboflavin status may be much more prevalent globally than generally recognized, including in high-income countries. Riboflavin biomarkers are rarely assessed in humans, with most studies reliant on dietary intakes only, therefore the health consequences of riboflavin deficiency remain largely uninvestigated. Our previous trials in non-pregnant adults demonstrated that supplemental riboflavin can significantly lower blood pressure (BP), specifically among individuals homozygous (TT genotype) for the common MTHFR C677T polymorphism. Little is known about the role of riboflavin in BP during pregnancy. The aim of this study was to examine the association of riboflavin status with BP, heart rate and risk of hypertension in pregnancy (HIP) at the 12th gestational week. Observational data from healthy Irish pregnant women enrolled in the OptiPREG study were analysed

($n = 2236$). Riboflavin status was determined using the functional assay erythrocyte glutathione reductase activation coefficient (EGRac), whereby higher values indicate lower riboflavin status. We identified a deficient riboflavin status ($EGRac \geq 1.40$) in 31% of participants, despite riboflavin supplement usage reported by the majority (64%). EGRac was a significant determinant of systolic ($\beta = 3.390$, $p = 0.011$) and diastolic ($\beta = 2.875$, $p = 0.003$) BP, following adjustment for gestational age, maternal age, BMI, parity, smoking and MTHFR genotype. Riboflavin deficiency was associated with an almost three-fold greater risk of developing HIP ($OR = 2.906$, $p = 0.041$). Within quartiles of riboflavin status, ranging from best (Q1) to poorest status (Q4), there were stepwise increases in heart rate (mean \pm SD, bpm; 79.9 ± 10.5 (Q1); 81.1 ± 9.7 (Q2); 81.8 ± 10.9 (Q3); 83.3 ± 11.3 (Q4), $p = 0.037$), following adjustment for gestational age, maternal age and BMI. The prevalence of HIP increased as riboflavin status deteriorated, with the highest prevalence observed among those with the poorest riboflavin status (4.3% (Q1); 4.9% (Q2); 6.6% (Q3); 8.0% (Q4), $p = 0.039$). The maintenance of an optimal riboflavin status in pregnancy, through improved diet, fortification and/or supplementation, may improve BP and heart rate, and reduce the risk of HIP. The observational findings presented here require confirmation in randomised trials with riboflavin in pregnancy, including the ongoing OptiPREG RCT.

Keywords: riboflavin; blood pressure; pregnancy; hypertension



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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data available on request pending application and approval.

Conflicts of Interest: There is a patent granted in Europe and pending elsewhere by H.M., M.W. and G.H. on the use of riboflavin in the treatment of hypertension; the other authors have no conflicts of interest to declare.

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N-3 Polyunsaturated Fatty Acid Intake and Status in Swiss Pregnant Women in Association with Antenatal Depressive Symptoms—A National Survey [†]

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Abstract: Background and objectives: During pregnancy, n-3 polyunsaturated fatty acid (PUFA) requirements increase in order to supply the needs of the growing and developing fetus. Furthermore, the risk of developing depressive symptoms increases during the perinatal period. n-3 PUFAs have been proposed to mitigate depressive symptoms. Little is known about the n-3 PUFA status of women in Switzerland. The objectives of this study were to assess the n-3 PUFA intake and status in

Swiss pregnant women and to explore associations with antenatal depressive symptoms. Methods:

This study formed part of the Swiss National Iodine Survey conducted in pregnant women in 2020–2022. We determined the intake of n-3 PUFA using a quantitative food frequency questionnaire and determined n-3 PUFA status by measuring fatty acid composition (% of total fatty acids) in dried blood spots. We assessed antenatal depressive symptoms by using the Edinburgh Postnatal Depression Scale (EPDS). Results: The mean n-3 index (converted to erythrocyte equivalents) in the final sample of 508 pregnant women (mean age 31.6 ± 4.3 years) was 4.59 ± 1.09. The n-3 index was higher in women taking an antenatal supplement containing n-3 PUFA (30%) than in their nonsupplemented counterparts (4.93 ± 1.23% vs. 4.46 ± 0.99%, *p* < 0.001). Furthermore, the n-3 index was significantly higher in women who consumed fish ≥ 1×/week (22%) and 1–3×/month (43%) than in women who consumed fish < 1×/month (34%) (4.95 ± 1.10% and 4.70 ± 1.02% vs. 4.35 ± 1.15%). The median (IQR) EPDS score was 4 (4, 5), and 12% and 6% of women had an EPDS score ≥ 11 and ≥ 13, respectively. Eicosapentaenoic acid (EPA) levels correlated negatively with EPDS scores (*r* = −0.105, *p* = 0.031), and were associated with lower odds of having an EPDS score ≥ 13, even after adjusting for potential confounders (OR = 0.02 [0.00–0.48]). Discussion: Our results indicate that Swiss pregnant women have a low n-3 PUFA status. Even though the n-3 PUFA status was higher in the women who reported taking a supplement containing n-3 PUFA or consumed fish ≥ 1×/week than in their respective counterparts, the n-3 PUFA status remained low in these groups. The association between the n-3 PUFA EPA and depressive symptoms further highlights the need for public health measures to optimize the n-3 PUFA status in Swiss pregnant women.

Keywords: pregnancy; n-3 index; depression; EPDS score; EPA; DHA; Switzerland

Author Contributions: Conceptualization, J.B. and I.H.-A.; methodology, J.B., M.A. and I.H.-A.; data analysis, J.B. and I.H.-A.; investigation, I.H.-A.; data curation, J.B. and I.H.-A.; writing—original draft preparation, J.B.; writing—review and editing, J.B., M.A. and I.H.-A.; project administration, I.H.-A.; funding acquisition, I.H.-A. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Anonymized data can be made available upon approval of a request after publication of the primary and secondary outcomes.

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Whole-Grain Intake in Mid-Life and Healthy Ageing in the Danish Diet, Cancer and Health Cohort [†]

Anne Kirstine Eriksen ^{1,*}, Mia Klinten Grand ², Cecilie Kyrø Pantou ¹, Jan Wohlfahrt ¹, Kim Overvad ³, Anne Tjønneland ¹ and Anja Olsen ¹



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Abstract: Background: The vast majority of populations are facing growth in the proportion of older persons. Hence, there is an interest in identifying factors associated with longer and healthier life in older ages. Lifestyle, including diet, is crucial for healthy life expectancy, but evidence to support more specific dietary guidelines easily implemented in real life is lacking. Whole grains are specific dietary components with unexplored potential in healthy ageing. Methods: Using an illness-death multistate model approach with a priori chosen confounder control, the association between whole-grain intake and expected time as “healthy” and “with disease” during 20 years of follow-up was assessed. Healthy ageing was defined as the absence of cancer, ischemic heart disease, stroke, type 2 diabetes, asthma, chronic obstructive pulmonary disease, and dementia. Results: Based on data from 22,606 men and 25,468 women from the Diet, Cancer and Health cohort with mean follow-up times of 14 to 17 years, respectively, a doubling in whole-grain intake was associated with 0.43 (95% CI: 0.33–0.52) and 0.15 (0.06–0.24) years more lived without disease, for men and women. When comparing extreme quartiles, men with the highest whole-grain intake lived on average one year more without disease than those consuming the least. Furthermore, whole-grain intake was inversely associated with life expectancy with disease. Conclusions: This study suggests that whole grains are associated with healthy ageing and inversely associated with life expectancy with disease after age 50. These findings should encourage guidelines for increased whole-grain intake, especially among those with low intake, to support disease-free good health in the last part of life.

Keywords: healthy ageing; whole grains; epidemiology

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Author Contributions: A.O., A.T. and K.O. contributed to the study concept and design. M.K.G. contributed to statistical methods, analysis and -support. A.K.E. conducted the data analysis and drafted the manuscript. A.K.E., A.O., A.T., C.K.P., J.W., K.O. and M.K.G. critically reviewed the final draft of the manuscript. All authors have read and agreed to the published version of the manuscript. **Funding:** This research received no external funding.

Institutional Review Board Statement: The Diet, Cancer and Health was approved by relevant Scientific Committees and the Danish Data Protection Agency.




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Quantifying the Coexistence of Multiple Forms of Malnutrition: A Systematic Literature Review and Meta-Analysis of Prevalence Estimates across Latin America [†]

Diana Sagastume ^{1,2,*} , Antonio Barrenechea-Pulache ¹, Manuel Ramírez-Zea ³, Lenka Benčová ¹ 
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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: Estimating the prevalence of the double burden of malnutrition (DBM) remains challenging in Latin America and the Caribbean (LAC), where DBM typologies are heterogeneous and estimates are scattered across the literature. We aimed to comprehensively appraise the evidence and estimate the prevalence of any typology of DBM in LAC. Methods: A systematic search was conducted on PubMed, Embase, Scopus and Web of Science to identify studies on the prevalence of DBM published in English, Spanish, French or Portuguese between 1 January 2000 and 23 January 2023. The primary outcome was any typology of DBM derived from combining levels (individual, household, across the life course) and identified DBM typologies. The data extraction and methodological quality assessment were conducted in duplicate. Random effect meta-analyses of proportions were used to estimate the pooled prevalence, stabilized using the Freeman–Tukey transformation. Heterogeneity was assessed using Cochran’s Q and I²-statistics. PROSPERO-CRD42023406755. Results: In total, 754 records were identified, of which 60 (8%) studies were eligible, with a median 4379 individuals, including 314 DBM estimates. Most studies were nationally representative surveys (68%), had a low risk of bias (70%) and came from South America (53%). In total, 40% of DBM estimates corresponded to the individual level, where the most frequent typologies were ‘overweight

+ stunting’ among <18 years, and ‘overweight + anemia’ among >18 years. The household level represented 59% of estimates, where ‘adults with overweight + child with stunting’ was the most frequent typology. The pooled prevalence of any typology of DBM was 4% (95% prediction interval: 4–5%). For the individual level, the most contributing typology for <18 year was ‘overweight + anemia’, 3% (2–5%), and for >18 year, ‘overweight + short stature’, 22% (14–30%). The typology of ‘adults with overweight + child with stunting, 9% (8–9%), contributed the most at the household level. The pooled prevalence estimates carried large heterogeneity (I² > 90%). The preliminary source of heterogeneity was the setting, as Mesoamerica and South America had 5% prevalence of DBM and the Caribbean had 2%. The DBM across individuals’ life course could not be estimated due to the scarcity of estimates. Conclusion: The prevalence of multiple forms of malnutrition in LAC varies between 2 and 5%. Adult with overweight are the most common contributor to DBM across levels and typologies. Substantial progress can be made in curbing the burden of DBM in LAC through strategies addressing overweight within the general population.



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Keywords: double burden of malnutrition; Latin America; meta-analysis

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Association between Physical Activity Energy Expenditure and Continuous Glucose Monitor-Derived Metrics: Data from the ZOE PREDICT 1 Study [†]

Harry A. Smith ¹, Kate M. Bermingham ^{1,2}, Anna May ¹, Jonathan Wolf ¹, Javier T. Gonzalez ³, Tim D. Spector ⁴ and Sarah E. Berry ^{2,*}



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Keywords: physical activity; continuous glucose monitoring; glycaemic variability; time in range

Background and objectives: Physical activity can improve glucose variability (GV) and time in range (TIR) in people with impaired glucose tolerance/diabetes [1,2]. However, the effects of physical activity on these parameters in people within normo-glycaemic ranges are unclear. This study explores the associations between physical activity, GV, and TIR in normo-glycaemic individuals from the ZOE PREDICT 1 cohort. **Methods:** Free-living continuous interstitial glucose (using continuous glucose monitoring) and activity energy expenditure (AEE; mean of 14 days using a wrist-based accelerometer [ENMO]) were collected in the ZOE PREDICT 1 study (n = 1002). TIR was calculated using (1) the American Diabetes Association criteria (TIR 3.9–7.8 mmol·L⁻¹) and (2) a novel ‘stringent’ range (TIR 3.9–5.6 mmol·L⁻¹) [3]. The relationship between AEE and glycaemic outcomes (GV and TIR) was assessed using partial correlations (adjusted for age, sex, and BMI). **Results:** Data from 698 participants (186 M/512 F) were analysed (mean ± SD; age: 45 ± 12 y; body mass index (BMI): 25.4 ± 4.8 kg·m⁻²; and estimated basal metabolic rate (BMR; Harris–Benedict equation): 1456 ± 225 kcal·d⁻¹). The mean fasting glucose concentration was 4.93 ± 0.42 mmol·L⁻¹ (range: 3.58–6.07 mmol·L⁻¹), and the mean daily glucose concentration was 5.02 ± 0.54 mmol·L⁻¹ (range: 3.43–7.19 mmol·L⁻¹). The median GV was 16.1% (IQR: 13.1–18.5%), and the median proportion of time spent in TIR 3.9–5.6 was 72.4% (IQR: 62.0–80.7%) compared to 95.3% (IQR: 87.7–99.0%) in TIR ADA.

AEE was inversely associated with TIR 3.9–5.6 (r = -0.09 p = 0.02), but not with TIR ADA (r = 0.03 p = 0.43), and positively associated with daily mean glucose concentration (r = 0.13, p < 0.001). **Discussion:** The data presented in this study suggest that, in normo-glycaemic individuals, higher activity energy expenditure is associated with a lower proportion of time spent within a novel ‘stringent’ range of interstitial glucose concentrations. However, the causality of this relationship is unclear, and future research should establish whether a higher physical activity level drives a higher glucose level, or vice versa.

Author Contributions: Study conceptualization and Methodology: H.A.S., K.M.B., A.M., J.T.G., S.E.B., T.D.S., J.W. Data Curation: S.E.B., J.W., T.D.S. Formal analysis, Validation and Visualisation: H.A.S., K.M.B.; Funding Acquisition: J.W., T.D.S. Study Investigation: S.E.B., J.W., T.D.S. Writing – Original Draft Preparation: H.A.S., K.M.B., A.M., J.T.G., S.E.B. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the London-Hampstead Research Ethics Committee (approval no. 18/LO/0663) and Integrated Research Application System (no. 236407) for studies involving humans.

Informed Consent Statement: Informed consent was obtained from all participants involved in the study.

Data Availability Statement: The data used for analysis in this study are held by the Department of Twin Research at King's College London and access can be requested from <https://twinsuk.ac.uk/resources-for-researchers/access-our-data/> (accessed on 10 November 2023) to allow for anonymisation and compliance with GDPR standards.

Conflicts of Interest: T.D.S. and J.W. are co-founders of Zoe Ltd. T.D.S. and S.E.B. are consultants to Zoe Ltd. K.M.B, H.A.S. are or have been employees of Zoe Ltd. H.A.S., A.M., J.W., T.D.S. and S.E.B. also receive options in ZOE Ltd. Other authors have no other conflicts of interest to declare.

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Multicenter Randomized Controlled Trial to Tackle Obesity through a Mediterranean Diet vs. A Low-Fat Diet in Children and Adolescents: Preliminary Results from the MED4YOUTH STUDY †

Alice Rosi ^{1,*} , Ricardo Teixo ^{2,3,4,5} , Nanci Batista ⁶, Lorena Calderón-Pérez ⁷, Antoni Caimari ⁷ and Francesca Scazzina ¹



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Keywords: Mediterranean Diet; youth obesity; BMI; KIDMED; edutainment

Background and objectives: Youth obesity is likely to persist into adulthood, so it is important to tackle it from childhood to prevent associated risks in the future. To this end, the Med4Youth study [1,2] aims to investigate whether a low-calorie Mediterranean Diet (MD) is as effective in counteracting youth obesity and associated risk factors for cardiovascular diseases as the traditional clinical intervention with a low-calorie low-fat diet (LFD). **Methods:** A multicenter randomized controlled trial was carried out in children and adolescents (11–17 years, 50% female) overweight or with obesity (>90th percentile) from Italy (n = 80), Portugal (n = 26), and Spain (n = 42). Both dietary interventions were combined with an educational web-application to increase engagement and knowledge of participants through a “learning-through-playing” approach, using educational materials and games. To assess the efficacy of the intervention, anthropometric and biochemical parameters, as well as adherence to the MD, physical activity, food frequency, sociodemographic, and quality of life questionnaires were evaluated. **Results:** In total, 148 volunteers were recruited and randomized in one of the intervention groups, and so far, 107 finished the 4 months of treatment. The BMI z-score, the primary outcome, showed a significant reduction in both the MD group and the LFD group in all countries, but no significant differences have been found between groups. An increase in the level of adherence to the MD, measured through the KIDMED questionnaire, was also observed in both groups, although the score was higher in the MD group at the end of the intervention. **Discussion:** These preliminary results indicate that the MD intervention did not produce any additional benefits in comparison to the control group, but it is not less effective than the conventional clinical treatment based on a reduction in fat intake. In conclusion, the MD could be an effective, easier to follow and more sustainable dietary intervention to treat youth obesity in Mediterranean countries. The final results at the end of the study will allow us to prove, or not, these preliminary conclusions.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki and it was approved by the Ethics Committee of the Institut d'Investigació Sanitària Pere i Virgili (Ref. 210/2020; 6 October 2020), the Area Vasta Emilia Nord (AVEN) (Ref. 1378, 14 January 2022), and the Centro Hospitalar e Universitário de Coimbra and Portuguese National Data Protection Commission (Ref. CHUC-197-20, 28 January 2021).

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the corresponding author on request.

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Conflicts of Interest: The authors declare no conflict of interest.

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Improved Cardiometabolic Health Using a Personalised Nutrition Approach: The ZOE METHOD Study [†]

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Keywords: randomised clinical trial; cardiometabolic health; personalised

Background: Large variability exists in people's responses to foods. However, the efficacy of personalised dietary advice for health remains understudied [1,2]. The ZOE METHOD trial (NCT05273268) compared the effects of following a personalised dietary program (PDP) versus the USDA recommended diet (control) on cardiometabolic health. **Methods:** A randomised clinical trial was conducted in 347 US-based participants aged 41–70 years, representative of the average US population. The PDP provided dietary advice that incorporated food characteristics, glucose and triglyceride (TG) responses to foods (1), individuals' microbiomes (2), and health history, to produce personalised food scores delivered as an 18-week program via the ZOE app. Primary outcomes were plasma low-density lipoprotein cholesterol (LDL-C) and TG concentrations measured at baseline and 18 weeks after random assignment to treatment. Secondary outcomes included weight, waist circumference, HbA1c, and microbiome composition. **Results:** In total, 86% of the participants were female, with a mean (\pm SD) age of 52 ± 7.5 y, BMI of 34 ± 5.8 kg/m², LDL-C of 3.7 mmol/L (95% CI: 3.3, 3.4), and TG of 1.4 mmol/L (95% CI: 1.3, 1.4). Intention to treat analysis ($n = 347$) showed a significant reduction in TG concentrations following PDP versus control; mean

difference in changes were -0.13mmol/L (log-transformed 95% CI: $-0.07, -0.01$, p -value = 0.016); mean within group changes were -0.21 mmol/L (95% CI: $-0.3, -0.1$) and -0.07 mmol/L (95% CI: $-0.2, -0.02$) in PDP and control, respectively. LDL-C did not differ between groups. There were reductions in body weight ($-2.5\text{ kg}, -3.7, -1.3$) and waist circumference ($-2.4\text{ cm}, -4.1, -0.6$), and increases in gut microbiome diversity (Bray–Curtis dissimilarity) following PDP against the control. Within the PDP treatment, highly adherent participants showed improvements (baseline versus 18-week) in LDL-C (by $-0.2 \pm 0.5\text{ mmol/L}$), waist circumference (by $-6.3 \pm 5.4\text{ cm}$), diastolic blood pressure (by $-4.1 \pm 8.6\text{ mmHg}$), and HbA1c (by $-0.06 \pm 0.2\%$), which were greater than low adherent participants ($p < 0.05$ for all). Discussion: Following the personalised dietary advice versus standard care for 18-week improved the TG, body weight, waist circumference, and gut microbiome composition, with greater improvements in highly adherent participants.

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Metabolic Hormone Levels in Infants Fed Formulas with Age-Adapted Protein Concentrations from Birth to 12 Months [†]

Jibrán A. Wali ^{1,*} , J. Manuel Ramos Nieves ¹, Corinne A. Zufferey ¹, Nicholas P. Hays ²  and Jean-Charles Picaud ³ 



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Abstract: Background: Breast milk protein content changes with the phases of lactation, whereas it is relatively static in infant formula (IF). The “early protein hypothesis” posits that higher protein intake in infancy increases insulin and IGF-1 secretion, exacerbating weight gain and increasing the risk of cardiometabolic disease. In

addition, the FGF-21 hormone also regulates metabolism by enhancing fat oxidation, energy expenditure, and insulin sensitivity. It is strongly induced by dietary protein restriction in adults and is inversely associated with growth rates in infancy. Here, we examined metabolic hormones in infants fed from 0 to 360 days, either standard or sequential IFs with age-adapted protein content, compared to breast-fed infants. Methods: Infants were randomized into two groups: 1. Standard Regimen-1 (n = 233): Standard IF (SIF = 1.85g protein/100kcal; 0–90 days) + Follow-up formula (FuF = 1.50g protein/100kcal; 90–360 days); 2. Age-adapted Regimen2 (n = 227): New IF (2.50g protein/100kcal; 0–30 days) + SIF (30–90 days) + FuF (90–360 days). Breast-fed infants (n = 231) served as a reference. Plasma insulin, C-peptide, IGF-1, and FGF-21 were measured at 30, 120, and 360 days by ELISA. Results: Insulin and C-peptide concentrations remained similar in Regimen-1 and -2 across 360 days and were significantly higher (up to +64%) than in breast-fed infants. Moreover, both IF regimens showed similar IGF-1 levels that were significantly higher (up to +26%) than breast-fed infants at 120 and 360 days. At 30 days, FGF21 levels were similar in BF and Regimen-1 but significantly lower in Regimen-2 infants. At 120 days, breast-fed infants showed a striking increase in FGF-21 levels (+42 and +74% higher vs. Regimen-1 and -2, respectively). At 360 days, FGF-21 in the breast-fed group remained significantly higher than Regimen-2 but not Regimen-1. These differences in FGF-21 levels were more prominent in males. Discussion: Overall, IGF-1, insulin, and C-peptide concentrations were similar between both IF regimens and significantly higher than in the breast-fed group. In contrast, FGF-21 levels were generally higher in the latter. Interestingly, the lower protein content of SIF in the first month (Regimen-1) brought FGF-21 levels closer to those observed in breast-fed infants. This study highlights FGF-21 as a possible novel mediator underpinning the early protein hypothesis.

Keywords: infant formula; breast milk; growth; protein; hormones; IGF-1; insulin; FGF-21; early protein hypothesis

Author Contributions: Conceptualization: J.A.W., J.M.R.N., N.P.H. and J.-C.P. Methodology: C.A.Z. Writing: J.A.W., J.M.R.N., N.P.H. and J.-C.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Written informed consent to participate in the study was provided by the participants’ parents/legal guardian.

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Identifying a Complex Carbohydrate Mixture in Context of a High-Protein Diet That Is Able to Steer Microbial Fermentation to Improve Metabolic Health: The DISTAL Study [†]

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Abstract: Background: The microbial metabolites short-chain fatty acids (SCFAs) are proposed to largely contribute to improvements in metabolic health associated with dietary fiber (saccharolytic) fermentation. Nevertheless, towards the distal colon, fermentable carbohydrates become depleted, and gut bacteria switches towards protein (proteolytic) fermentation. This yields a diversity of metabolites like branched-chain fatty acids (BCFAs), often considered detrimental to metabolic health. We previously demonstrated that acute SCFA administration to the distal, but not the proximal colon, led to beneficial alterations in human substrate and energy metabolism. Hence, we hypothesize that a switch from proteolytic to saccharolytic fermentation in the distal colon has the most pronounced metabolic health effects and aimed to identify a complex carbohydrate mixture capable of inducing such a microbial substrate switch. Methods: The TIM-2 model, an in vitro computer-controlled dynamic model, was used to mimic colonic fermentation, simulating amongst others body temperature, luminal pH, microbial metabolite absorption, and peristalsis. TIM-2 was inoculated with standardized pooled microbiota from individuals with overweight/obesity and disturbed glucose homeostasis. After an overnight adaptation period, pre-digested proteins were added to the model to create a high protein background. Subsequently, either separately or in combination, potato fiber, native inulin from chicory, pectin from sugar beet, or no fibers (protein control) were administered. Samples of the lumen and dialysate were taken at various time points and assessed for proximal (0–8 h) and distal (8–24 h) SCFA and BCFA levels. Results: Of all the tested combinations, combining potato fiber and pectin resulted in the highest distal SCFA production (26.3 vs 6.4 mmol) and SCFA:BCFA ratio (13.3 vs 2.2) compared to the protein control. Discussion: The combination of potato fiber and pectin was best able to increase distal SCFA production in pooled microbiota of individuals who were overweight/obese. To assess whether these results translate to improvements in metabolic health, we are currently conducting a 12-week double-blind placebocontrolled randomized study. 44 individuals who are overweight/obese and have a disturbed glucose homeostasis are randomized to supplementation with a potato fiber/pectin mixture or placebo (maltodextrin) while consuming an eucaloric high protein diet (25 E% protein). The primary outcome will be the change in peripheral insulin sensitivity.

Keywords: dietary fibers; SCFA; metabolic health; obesity

Author Contributions: Conceptualization, T.v.D., E.B. and K.V. Writing—original draft preparation, T.v.D. Writing—review and editing, E.B., K.V. and C.v.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki, and the human intervention study was approved by the Institutional Review Board (or Ethics Committee) of METC (METC22-011, NL80459.068.22, 25-05-2023). ClinicalTrials.gov Identifier: NCT05354245.

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The Future Burden of Type 2 Diabetes in Belgium: A Microsimulation Model [†]

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Abstract: Background: Over 60 million people in Europe live with type 2 diabetes (T2D). This high burden is influenced by factors like population aging and increasingly prevalent risk factors such as excess weight, physical inactivity, unhealthy diets, and smoking. Addressing these factors from a public health perspective is challenging due to their complex interactions. Using current data, this study aims to predict the future burden of T2D in Belgium until 2030, as a benchmark to guide preventive strategies. Methods: This study utilized a discrete-event transition microsimulation model. A synthetic population was created using national census data of the Belgian population aged 0–80 years, along with the representative prevalence of diabetes risk factors obtained from the latest

(2018) Belgian Health Interview and Examination Surveys. To create the synthetic population, the Simulation of Synthetic Complex Data and Multiple Imputation by Chained Equations method was used. Mortality information was obtained from the Belgian Standardized Procedures for Mortality Analysis database and used to calculate annual death probabilities. From 2018 to 2030, synthetic individuals transitioned annually from health to death, with or without developing type 2 diabetes, as predicted by the Finnish Diabetes Risk Score, and risk factors were updated via strata-specific transition probabilities. Results: A total of 6722 (95%UI: 3421 and 11,583) new cases of type 2 diabetes per 100,000 inhabitants are expected between 2018 and 2030 in Belgium, representing a 32.8% and 19.3% increase in T2D prevalence rate and DALYs rate, respectively. While T2D burden remained highest for lower-education subgroups across all three Belgian regions, the highest increases in incidence and prevalence rates by 2030 are observed for women in general, and particularly among Flemish women reporting higher education levels, with a 114% and 44.6% increase in prevalence and DALYs rates, respectively. Existing age- and education-related inequalities will remain apparent in 2030 across all three regions. Conclusion: The rising burden of T2D in Belgium underscores the importance of preventive strategies. Priority should be given to lower-education groups, but strategies must also be strengthened for individuals of higher socioeconomic status, as they are expected to experience a significant increase in T2D burden.

Keywords: diabetes 1; microsimulation; forecast



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assembled the first draft of the manuscript and the technical annex, and J.L.P. wrote the final version. All authors have read and agreed to the published version of the manuscript.

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Disentangling the Immunomodulatory Effects of Vitamin D on the SARS-CoV-2 Virus by In Vitro Approaches [†]

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Abstract: Vitamin D is a fat-soluble vitamin with multiple functions, including the modulation of the immune response, amongst others. Earlier studies have demonstrated that the active form of vitamin D, 1,25-dihydroxivitamin D, inhibits LPS-induced IL-6 and TNF- α production by human monocytes in a dose-dependent manner. On the other hand, some in vitro studies support that this vitamin has immune modulatory effects on viral infections. However, it remains unclear whether vitamin D regulates the immune response in infectious diseases triggered by viruses such as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which causes COVID-19. This study aimed to evaluate the anti-inflammatory properties of vitamin D against the spike protein of the SARS-CoV-2 virus. For this purpose, vitamin D was used in two different doses of 10 and 25 nM on the THP-1 cell line, which was stimulated with low doses of the SARS-CoV-2 virus spike protein. The THP-1 cell line, which is derived from human monocytic cells, was chosen since it contains the ACE2 transporter of the spike protein. Moreover, it is a widely used model to examine inflammatory processes due to its potential to stimulate inflammation and the release of inflammatory cytokines. The THP-1 cells were incubated for 1 h with the spike protein, subsequently treated with the two selected doses of vitamin D and incubated for 24 h. ELISA and RT-qPCR techniques were used to quantify the levels of inflammatory cytokines. Our results showed that vitamin D had no effect on the mRNA transcriptional levels of cytokine IL-6, but it was able to down-regulate the transcriptional levels of the pro-inflammatory cytokines IL-1 β and TNF- α . There was no dose–response relationship between vitamin D and the expression of these genes. In conclusion, vitamin D inhibited inflammatory cytokine production on spike protein-stimulated inflammation in the THP1 cell line. The study is being completed by testing higher doses of vitamin D and of the spike protein. Additionally, other markers of inflammation are being measured through the use of transcriptomic analyses of the control vs. treated THP1 cells.

Keywords: vitamin D; SARS-CoV-2 virus; immunomodulatory effects

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Cluster Profiles of Health Metabolic Markers and Vitamin D [†]

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Abstract: Vitamin D (VD) is an essential nutrient for which deficiency is highly prevalent and worthy of attention. In fact, VD deficiency may increase the risk of developing chronic diseases, including cardiovascular disease, diabetes and metabolic syndrome, and cancer. Recent studies have also reported a link between VD deficiency, comorbid conditions, and infectious diseases such as COVID-19, which is caused by the Sars-CoV-2 virus. The impact of VD deficiency on the metabolomic profiles of some of these diseases is poorly understood. The aim of this study was to analyse the relationship between VD and some metabolomics/biochemical markers. Metabolomics data

(249 NMR-derived Nightingale Health markers) and some common biochemical markers related to VD and inflammation (VD, CRP, IGF-1, GGT, and steroid hormones, among others) were taken from the UK BIOBANK database. Two sets of markers were subjected to a hierarchical clustering analysis after data normalization: (i) the metabolomics-derived markers with VD (N = 10,000 randomly selected subjects) and (ii) the metabolomics-derived markers with all other biochemical markers (N = 674 subjects with complete data). Ward's inter-cluster linkages and Euclidean and Manhattan distances were applied to group the markers and subjects based on their similarity. The silhouette method was considered to choose the optimal number of clusters. The results showed three distinctive clusters of subjects and three clusters of metabolites. The first cluster of HDL-related metabolites defined subjects with high, intermediate, and low levels of these metabolites. The second cluster of metabolites included VD, inflammatory markers (CRP and IGF-1), branched-chain amino acids (Valine, Isoleucine, and Leucine), polyunsaturated fatty acids, markers of the acetate metabolism, and LDL-related markers. VD showed a heterogeneous trend across the clusters of subjects. The third cluster comprised other cholesterol-related markers. Results were consistent in both sets of markers and distance matrixes. In conclusion, this exploratory study suggests that VD aggregates with key metabolic markers of energy metabolism and inflammation, pointing to synergistic mechanisms through which these markers could modulate metabolic disorders. These markers, however, do not seem to define subgroups of subjects with VD deficiency. Analyses are underway to explore the influence of other VD-related variables on these results.

Keywords: vitamin D; clusters profiles; metabolic markers

Author Contributions: Conceptualization, E.M.-M., M.R.-B., C.R.-P., M.J.S. and Á.A.-S.; methodology, Á.A.-S.; formal analysis, Á.A.-S.; investigation, Á.A.-S. and E.M.-M.; resources, Á.A.-S.; data curation, Á.A.-S. and E.M.-M.; writing—original draft preparation, Á.A.-S.; writing—review and editing, E.M.-M., M.R.-B., C.R.-P. and M.J.S.; supervision, E.M.-M.; project administration, E.M.-M.; funding acquisition, E.M.-M. All authors have read and agreed to the published version of the manuscript.

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Development and Validation of Nutri S-Can, a Short Screener to Evaluate Adherence to the 2018 WCRF/AICR Cancer Prevention Recommendations [†]

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Abstract: There is a lack of rapid dietary assessment tools to screen for compliance with guidelines for cancer prevention, such as those issued by the World Cancer Research Fund and the American Institute for Cancer Research. Our aim was to develop and validate a short screener (Nutri S-Can) to evaluate adherence to these recommendations, with the potential to be used in cancer prevention strategies. Four stages were defined: development, pilot study, refinement and validation study. The Nutri S-Can captures several domains of the WCRF/AICR recommendations: body composition, physical activity, diet, alcohol consumption, and breastfeeding. A first version was piloted in $n = 100$ PREDIMED-Plus study participants, for which comprehensive dietary, physical activity, and anthropometric measurements were available (+/– 6 months). Nutri S-Can was retested 6 months later in a subsample of 60 participants. Its validity was evaluated by comparing total and individual domain scores of the screener to those obtained from validated methods (breastfeeding not validated), and its reproducibility was measured comparing the first to the second administration (Pearson correlation). The first version of the Nutri S-Can included 15 questions distributed across five domains. Each question had three possible answers to determine whether participants meet (1 point), partially meet (0.5) or do not meet (0) the recommendations (score range: 0–7). Participant’s average age was 71.4 ± 5.03 y (41 women, 59 men), taking an average of 6.9 min to complete the screener. The total average score was 4.9 ± 0.9 vs. 3.5 ± 0.9 using data from validated questionnaires (high correlation; $r = 0.51$). Individual domains presented a high and significant correlation ($r = 0.25$ – 0.85) when comparing Nutri S-Can to validated assessments, except for processed foods ($r = 0.15$). A high correlation ($r > 0.3$) was observed when comparing Nutri S-Can before and after 6 months for individual dimensions and overall score. The refinement study aimed to increase preciseness and accuracy: two additional questions were included (total: 17 questions) to reduce the under-estimation of processed foods and improve self-classification of physical activity, and the n° of answers available was increased to six. This final version is being validated in two different populations (university students ($n = 100$) and PREDIMED-Plus participants ($n = 117$)) with the aim of having a validated screener that can be used in clinical settings at the individual level.

Keywords: cancer; screener; diet; validation study



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writing—review and editing, D.R. and A.C.; visualization, D.R. and A.C.; supervision, D.R.; project administration, D.R. and A.S.; funding acquisition, D.R. and A.S. All authors have read and agreed to the published version of the manuscript.

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Protocol for the Systematic Review of the Biologic Pathways Linking Diet, Nutrition, and Physical Activity with Cancer: World Cancer Research Fund Global Cancer Update Project [†]

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Abstract: Background and Objectives: Biological and mechanistic data can support observational evidence to aid causal inference. The substantial body of available epidemiological evidence on the role of diet, nutrition, physical activity, and body weight and cancer has been systematically reviewed within the World Cancer Research Fund Global Cancer Update Program (WCRF CUP Global) over the past few decades. Mechanistic data can provide substantial additional support to established or suspected associations between diet and cancer but has not previously been systematically reviewed within the CUP Global. Here, we describe the development of a framework for the evaluation of biological and mechanistic data to support CUP Global in their evaluations. Methods: The protocol to evaluate mechanistic data utilizes a two-stage, iterative approach: (1) use of expert knowledge in combination with text mining automated tools (<https://www.temmpo.org.uk/> accessed on 14 February 2024) to identify a set of the main potential mechanisms (typically 2–3 mechanisms) and their associated intermediate phenotypes (IPs) that link the factor of interest (exposure: E) to the cancer outcome of interest (outcome: O) and (2) for selected mechanisms, perform systematic literature reviews of human studies to evaluate the associations between E and IPs and between IPs and O. An expert committee then assesses the level of evidence for the role of each potential mechanism in the E–O association. If appropriate, additional literature reviews of experimental studies will be performed to address specific questions. Results: A protocol has been developed that can be used to systematically review data on mechanisms in a timely manner. As a first test case, the proposed protocol will be tested to evaluate mechanisms linking dietary patterns and colorectal cancer development. Discussion: This project will produce a framework for the systematic evaluation of mechanistic research to support causal associations between diet, nutrition, physical activity, body weight and cancer risk within WCRF CUP Global.

Keywords: protocol; biological pathways; mechanisms; cancer; nutrition

Author Contributions: Conceptualization, E.M.G.-G., S.L., H.C., V.G.-D., B.L.-S., M.J.G. and L.D., methodology, S.L. and L.D.; formal analysis, E.M.G.-G. and L.D.; data curation, E.M.G.-G. and L.D.; writing—original draft preparation, E.M.G.-G., S.L., B.L.-S., M.J.G. and L.D.; writing—review and editing, E.M.G.-G., S.L., H.C., V.G.-D., B.L.-S., M.J.G. and L.D.; funding acquisition, M.J.G. and L.D. All authors have read and agreed to the published version of the manuscript.

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Engineered *Escherichia coli* Nissle 1917 Expressing IGF1 and FGF19 Reduce Liver Fat Accumulation and Restore Microbial Equilibrium in a Metabolic Dysfunction-Associated Steatotic Liver Disease Mice Model [†]

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Abstract: Background and objectives: Endocrine dysregulation and intestinal microbiota unbalance are commonly associated with metabolic dysfunction-associated steatotic liver disease (MASLD). We aimed to investigate the effectiveness of engineered probiotic *Escherichia coli* Nissle (EcN) 1917 expressing various hormones (IGF1, GLP-1, FGF19, Adiponectin) downregulated in MASLD as a potential therapeutic. Methods: 41 C57BL/6J mice underwent 14 weeks of a high-fat diet intervention for MASLD development. The mice were then separated into seven groups and underwent 7 weeks of probiotic intervention while under the control diet. The mice were grouped as follows: (1) without probiotic; (2) EcN without hormone expression; (3–6) EcN expressing IGF1, GLP-1, FGF19, and Adiponectin, respectively; and (7) liraglutide treatment. Liver fat was measured using MRI and the Oil-Red-O staining of liver histological samples. 16s rRNA sequencing was used to investigate the bacterial composition in mice cecum. Results: Mice receiving EcN expressing IGF1, GLP-1, and FGF19 were effective at reducing liver fat accumulation. Microbiota compositions were different between groups, and the microbial communities of mice receiving EcN expressing IGF1 and FGF19 had higher observed richness. Mice receiving EcN-IGF1 had lower abundance of sulfate-reducing bacteria (*Desulfobacterota*) associated with gut inflammation and higher abundance of butyrate-producing bacteria (*Roseburia* sp.) and *Lactobacillus reuteri*. Mice receiving EcN-FGF19 had lower abundance of bacteria associated with intestinal inflammation (*Coriobacteriia*) and higher abundance of SCFA-producing bacteria (*Roseburia* sp. and *Blautia* sp.) and plasma propionate levels. Discussion: EcN expressing IGF1 and FGF19 have the potential to reduce liver fat accumulation and restore microbial equilibrium. This may be a combined effect of hormones and EcN, as a probiotic, thereby improving gut endocrine and immune functions.

Keywords: advanced microbial therapeutics; metabolic dysfunction-associated steatotic liver disease; metabolic disease; gut microbiome

Author Contributions: Conceptualization: J.L., V.I., C.G.-G., R.V.-U., M.O.A.S., M.K. and H.E.-N.; data curation and formal analysis: J.L., V.I. and C.G.-G.; writing—original draft preparation, J.L.; writing—review and editing, J.L., V.I., C.G.-G., R.V.-U., M.O.A.S., M.K. and H.E.-N.; supervision, C.G.-G., M.O.A.S., M.K. and H.E.-N.; funding acquisition, M.O.A.S., M.K. and H.E.-N. All authors have read and agreed to the published version of the manuscript.

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Effects of Curcumin, Resveratrol, and Quercetin on Endometriosis and Polycystic Ovaries Syndrome—A Review [†]

Lejla Mujezin ^{1,*}, Adna Salkic' ² and Milka Popovic' ^{3,4} 



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Abstract: Background and objectives: Endometriosis is a condition, in which tissue similar to the lining of the uterus grows outside of it. Polycystic ovarian syndrome (PCOS) is a heterogeneous endocrine disorder, caused by the imbalance of androgen hormones. This study aims to shed light on the mechanisms of action and efficiency of curcumin, resveratrol, and quercetin, polyphenols found in medicinal plants and foods, in the treatment of endometriosis and PCOS. Methods: The literature review from PubMed/Medline, Embase electronic databases, and Google Scholar databases with the keywords related to the study topic is used as a research methodology. Only studies with supplemental herbal products intervention in patients with diagnosed PCOS or endometriosis were included. Results: An interventional study

conducted on women with endometriosis, diagnosed using laparoscopy, showed that curcumin administered in the solution concentrations of 30 $\mu\text{mol/L}$ and 50 $\mu\text{mol/L}$ reduced the number of E2 endometriotic stromal cells and slowed their growth. A systematic review showed that curcumin administered in doses of 80 mg and 500 mg decreased body mass index, fasting plasma glucose, insulin, homeostatic model assessment for insulin resistance, total cholesterol, and C-reactive protein (CRP) among patients with PCOS. An interventional study among 40 patients with PCOS, showed that resveratrol administered in a dose of 800 mg/day decreased the serum levels of interleukin (IL)-6, IL-1 β , tumor necrosis factor α (TNF- α), IL-18, NF- κB , and CRP. A randomized clinical trial found that the intake of resveratrol in a dose of 40 mg/day with the monophasic contraceptive pill reduced the pain scores in women with a diagnosis of endometriosis. A systematic review reported that 1000 mg of quercetin improved PCOS-related indexes and the levels of estradiol among women in experimental studies. An experimental study showed that quercetin had antiproliferative effects in vitro and in vivo, by cell accumulation at subG0/G1 phase and apoptotic function in endometriosis cells. Discussion: Curcumin, resveratrol, and quercetin have various effects on PCOS and endometriosis and are effective through various mechanisms of action. Nevertheless, more studies are needed to evaluate the polyphenols' efficiency in detail, especially the effects of resveratrol and quercetin in humans.

Keywords: endometriosis; PCOS; curcumin; resveratrol; quercetin

Author Contributions: Conceptualization, L.M. and A.S.; methodology, M.P.; software, M.P.; validation, L.M., A.S. and M.P.; formal analysis, L.M.; investigation, L.M.; resources, A.S.; data curation, M.P.; writing—original draft preparation, M.P.; writing—review and editing, L.M.; visualization, A.S.; supervision, L.M.; project administration, L.M.; funding acquisition, A.S. All authors have read and agreed to the published version of the manuscript.

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Investigation to Isolate the Acute Metabolic Effects of Carbohydrate Restriction on Postprandial Substrate Metabolism with or without Energy Restriction [†]

Hayriye Biyikoglu *, Adam Collins and Denise Robertson



Citation: Biyikoglu, H.; Collins, A.; Robertson, D. Investigation to Isolate the Acute Metabolic Effects of Carbohydrate Restriction on Postprandial Substrate Metabolism with or without Energy Restriction. *Proceedings* **2023**, *91*, 396. <https://doi.org/10.3390/proceedings2023091396>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Intermittent energy-restricted diets have shown improved metabolic health and alterations in postprandial glucose and lipid responses. Given these diets' inherent low carbohydrate content due to fasting and carbohydrates' crucial role in postprandial metabolism, it is essential to determine if the observed benefits are primarily due to decreased carbohydrate consumption. This study aims to evaluate the acute metabolic effects of carbohydrate restriction on postprandial substrate metabolism, both in the presence and absence of energy restriction, compared to an iso-caloric balanced diet. Twelve (six male) healthy adults (27.33 ± 1.82 ; 26.64 ± 1.64 kg/m²) participated in this acute, three-arm crossover study. Participants consumed three pre-prepared intervention diets for one day (36 h), each separated by a 5-day washout period: a normal-carbohydrate (55% of energy) energy-balanced diet (nEB), a low-carbohydrate (50 g/day) energy-balanced (100% energy) diet (LCEB), and a low-carbohydrate (50 g/day) energy-restricted (25% energy) diet (LC25). Following each 36 h diet phase, blood metabolites were measured in the morning fasted state and serially across 360 min postprandially. Concurrently, substrate utilization (RQ) and energy expenditure were evaluated using indirect calorimetry. Data were analysed using repeated-measures ANOVA and Wilcoxon signed-ranks, with results displayed as mean \pm SEM. Resting energy expenditure and postprandial thermogenesis showed no significant difference across the three study arms ($p > 0.05$) although RQ was markedly decreased in both LC arms ($p < 0.001$). Elevated hepatic 3- β -hydroxybutyrate production was observed in both low-carb groups compared to control ($p < 0.01$). Following 36 h of both low-carbohydrate diet improved postprandial TAG levels ($p < 0.001$). However, glucose tolerance was impaired in both low-carb diets ($p = 0.04$), while insulin responses showed no statistical difference between all diets ($p > 0.05$). Fasted and postprandial NEFA levels increased in both low-carb diets ($p = 0.02$, $p < 0.01$, respectively). Similarly, fasting GLP-1 levels rose in low-carb arms ($p < 0.5$), declining postprandially ($p < 0.05$). No significant difference was found between them in all analysed parameters ($p < 0.05$). This data suggest that limiting carbohydrates without concurrent energy restriction can mimic the short-term metabolic effects of fasting. Further research is needed to evaluate the long-term impacts of intermittent low-carb diets and their viability as alternatives to traditional energy-restricted plans, factoring in tolerance, sustainability, and lasting physiological effects.

Keywords: carbohydrate restriction; intermittent energy restriction

Author Contributions: H.B. participated in the concept, design, execution of the study, laboratory work, statistical analysis and preparation of the manuscript; D.R. helped conceptualize, design, and prepare the manuscript of the study; A.C. was involved in the study concept, design, statistical analysis, and preparation of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Investigation to Isolate the Acute Metabolic Effects of Carbohydrate Restriction on Postprandial Substrate Metabolism with or without Energy Restriction [†]

Hayriye Biyikoglu *, Adam Collins and Denise Robertson



Citation: Biyikoglu, H.; Collins, A.; Robertson, D. Investigation to Isolate the Acute Metabolic Effects of Carbohydrate Restriction on Postprandial Substrate Metabolism with or without Energy Restriction. *Proceedings* **2023**, *91*, 396. <https://doi.org/10.3390/proceedings2023091396>

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Abstract: Intermittent energy-restricted diets have shown improved metabolic health and alterations in postprandial glucose and lipid responses. Given these diets' inherent low carbohydrate content due to fasting and carbohydrates' crucial role in postprandial metabolism, it is essential to determine if the observed benefits are primarily due to decreased carbohydrate consumption. This study aims to evaluate the acute metabolic effects of carbohydrate restriction on postprandial substrate metabolism, both in the presence and absence of energy restriction, compared to an iso-caloric balanced diet. Twelve (six male) healthy adults (27.33 ± 1.82 ; 26.64 ± 1.64 kg/m²) participated in this acute, three-arm crossover study. Participants consumed three pre-prepared intervention diets for one day (36 h), each separated by a 5-day washout period: a normal-carbohydrate (55% of energy) energy-balanced diet (nEB), a low-carbohydrate (50 g/day) energy-balanced (100% energy) diet (LCEB), and a low-carbohydrate (50 g/day) energy-restricted (25% energy) diet (LC25). Following each 36 h diet phase, blood metabolites were measured in the morning fasted state and serially across 360 min postprandially. Concurrently, substrate utilization (RQ) and energy expenditure were evaluated using indirect calorimetry. Data were analysed using repeated-measures ANOVA and Wilcoxon signed-ranks, with results displayed as mean \pm SEM. Resting energy expenditure and postprandial thermogenesis showed no significant difference across the three study arms ($p > 0.05$) although RQ was markedly decreased in both LC arms ($p < 0.001$). Elevated hepatic 3- β -hydroxybutyrate production was observed in both low-carb groups compared to control ($p < 0.01$). Following 36 h of both low-carbohydrate diet improved postprandial TAG levels ($p < 0.001$). However, glucose tolerance was impaired in both low-carb diets ($p = 0.04$), while insulin responses showed no statistical difference between all diets ($p > 0.05$). Fasted and postprandial NEFA levels increased in both low-carb diets ($p = 0.02$, $p < 0.01$, respectively). Similarly, fasting GLP-1 levels rose in low-carb arms ($p < 0.5$), declining postprandially ($p < 0.05$). No significant difference was found between them in all analysed parameters ($p < 0.05$). This data suggest that limiting carbohydrates without concurrent energy restriction can mimic the short-term metabolic effects of fasting. Further research is needed to evaluate the long-term impacts of intermittent low-carb diets and their viability as alternatives to traditional energy-restricted plans, factoring in tolerance, sustainability, and lasting physiological effects.

Keywords: carbohydrate restriction; intermittent energy restriction

Author Contributions: H.B. participated in the concept, design, execution of the study, laboratory work, statistical analysis and preparation of the manuscript; D.R. helped conceptualize, design, and prepare the manuscript of the study; A.C. was involved in the study concept, design, statistical analysis, and preparation of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Meal Glycemic Load, Meal Frequency, and Alertness: Mediation Effect of Glucose Concentration [†]

Perdana S. T. Suyoto, Mariëlle G. de Rijk, Jeanne H. M. de Vries  and Edith J. M. Feskens * 



Citation: Suyoto, P.S.T.; de Rijk, M.G.; de Vries, J.H.M.; Feskens, E.J.M. Meal Glycemic Load, Meal Frequency, and Alertness: Mediation Effect of Glucose Concentration. *Proceedings* **2023**, *91*, 387. <https://doi.org/10.3390/proceedings2023091387>

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Abstract: Background and objectives: Night shift workers experience circadian disruption that may manifest in poor

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alertness. This study aimed to explain the mediation by acute glucose concentration resulting from the assignment of meals varying in glycemic load (high and low) and meal frequency (1 and 3) on alertness parameters, including the number of lapses, reaction time median (RTMed), and variability (RTVar). Methods: A two-arm randomized cross-over trial was conducted on female nurses working night shifts. In each of the study arms, the 1-MEAL and 3-MEAL arms, the participants followed three intervention periods consisting of the provision of high glycemic load (GL) or low GL meals in the form of yogurts with either dextrose added or the combination of lactose and fructose or fasting (no meal) during three consecutive night shifts with a 2-week washout period. In the 1-MEAL arm, the participants were provided with one meal (1-high GL or 1-low GL), while three meals were provided in the 3-MEAL arm (3-high GL or 3-low GL). Twenty-four-hour interstitial glucose concentrations were measured using continuous glucose monitors during the interventions. The participants performed brief psychomotor vigilance tasks (PVT-B) at 04:00 h. Mediation analysis was performed to determine whether the meal glycemic load effect on the number of lapses, RTMed, and RTVar was explained by the mean glucose concentration 120 min prior to performing the PVT. Result: A mediation effect of mean glucose concentrations on RTVar was observed, for instance, in

1-high GL ($\beta_{\text{ind}} = 16.23$ mmol/L, 95%CI: 1.62, 33.89) and 3-high GL ($\beta_{\text{ind}} = 8.85$ mmol/L, 95%CI: 0.90, 19.33) compared to no meal. Significant mediation effects of mean glucose concentrations on RTVar were also detected between 3-high vs. 1-high GL, 1-high GL vs. 1-low GL, and 3-high GL vs. 3-low GL. However, no mediation effect was observed on the number of lapses or RTMed.

Discussion: In summary, mediation analysis suggests that an elevated mean glucose concentration 120 min prior to performing the PVT increased the reaction time variability, indicating difficulties in maintaining attention.

Keywords: alertness; glycemic load; meal frequency; glucose; night shift

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Effects of a Diabetes-Specific Formula on Glycemic Control and Cardiometabolic Risk Factors in Overweight and Obese Adults with Type 2 Diabetes: Results from a Randomized Controlled Trial [†]

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Abstract: Lifestyle modification, including nutrition therapy, plays an important role in diabetes management. The objective of this randomized controlled trial was to investigate the effects of a diabetes-specific formula (DSF) on glycemic control and cardiometabolic risk factors in individuals with type 2 diabetes. A total of 251 adult men and women with type 2 diabetes on oral antihyperglycemic medication(s) were enrolled, and 235 were randomly assigned to one of two study treatments: (i) DSF with standard of care (DSF group) ($n = 117$) or (ii) standard of care alone (control group) ($n = 118$). The DSF group was asked to consume either one serving of DSF (if baseline BMI ≥ 23.0 and <27.5 kg/m²) or two servings of DSF (if baseline BMI ≥ 27.5 and <35.0 kg/m²) as a meal replacement (MR) or partial MR. Blood biomarkers, anthropometry, body composition, and blood pressure were assessed at baseline, day 45, and day 90. Mean (SE) HbA1c of participants was 7.94 (0.05)% and BMI was 28.37 (0.21) kg/m² at baseline. The DSF group had a significantly greater reduction in HbA1c than the control group at day 45 (-0.44% vs. -0.26% ; $p = 0.015$) and day 90 (-0.50% vs. -0.21% ; $p = 0.002$). Fasting blood glucose was significantly lower in the DSF group at Day 90 (-0.14 mmol/L vs. $+0.32$ mmol/L; $p = 0.036$). The DSF group lost twice as much weight as the control group at day 45 (-1.30 kg vs. -0.61 kg; $p < 0.001$) and day 90 (-1.74 kg vs. -0.76 kg; $p < 0.001$). Waist circumference, hip circumference, fat mass, and visceral adipose tissue were significantly lower in the DSF group compared to the control group (all overall $p \leq 0.004$). The DSF group also had significantly lower diastolic blood pressure (overall $p = 0.045$) and systolic blood pressure at day 90 ($p = 0.043$). This study demonstrated that consuming DSF as a MR or partial MR in addition to the standard of care resulted in significantly greater improvements in glycemic control and cardiometabolic risk factors in overweight and obese adults with type 2 diabetes compared to the standard of care alone.

Keywords: type 2 diabetes; nutrition therapy; meal replacement; diabetes-specific formula; glycemic control; body composition; cardiometabolic risk factors

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Predictors of Reduced Bone Mineral Density in Children and Adolescents with Anorexia Nervosa [†]

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Abstract: The complexity of eating disorders, especially anorexia nervosa (AN), is associated with reduced bone mass (RBM) caused by much more than calorie restriction. The aim of this study was to determine the predictors of reduced bone mass (RBM) in children and adolescents with anorexia nervosa (AN), with the consideration of endotypes. This retrospective study with prospective data collection enrolled 197 hospitalized patients, including 65% with a restrictive type, 25% with a purgative type and 10% with an Eating Disorder Not Otherwise Specified. At the time of hospitalization, the patients already had a noticeable RBM, which did not differ according to their endotype. The age of patients at the time of hospitalization (14.9 ± 2.5 years) was confirmed as an independent risk factor for SKM (41.1% higher risk in older patients). Prevalence of RBM did not differ between the endotypes. However, at the time of hospitalization, the patients already had an RBM, which did not differ by the endotype. Patients' age at hospitalization (14.9 ± 2.5 years) is an independent risk factor for RBM (41.1% higher risk with older age). Body mass at hospitalization directly correlates with bone density ($r = 0.531$; $p < 0.01$) and is another independent risk factor for RBD. The risk drops by 9.6% per each kg of body mass more at hospitalization and by 5.7% per each kg body mass more before the diagnosis. Interestingly, longer nutritional support during hospitalization (per day) independently reduces the risk of RBM by 8.4%. The results confirm RBM, which worsens with AN duration, regardless of the endotype. There is a need for an early diagnosis and adequate physical recovery in order to prevent long-term consequences from fractures to osteoporosis.

Keywords: anorexia nervosa; adolescents; bone mineral density; body mass; nutritional support

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Fatty Acid Profile and Health Lipid Quality Indices of Daily Meals Provided in Kindergartens in Novi Sad, Serbia [†]

Radmila Velicki ^{1,2,*}, Milka Popovic ^{1,2} , Sanja Bijelovic ^{1,2} and Ljilja Torovic ^{2,3}



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Abstract: Dietary fats, consisting of fatty acids (FAs), have diverse implications for disease prevention and treatment. Understanding the quality of dietary lipids is essential for managing chronic conditions and establishing food-based dietary guidelines. FAs naturally occur as mixtures of saturated (SFAs), monounsaturated (MUFAs), and polyunsaturated FAs (PUFAs), and their nutritional and medicinal values are evaluated using specific indices. This study aimed to assess the FA profiles and lipid quality indices of daily meals served in kindergartens located in Novi Sad, Serbia. During the autumn, winter, and spring seasons of the 2022/2023 year, meal (breakfast, snack, and lunch) sampling was conducted in a randomized manner on 15 unannounced days in each season. The nutritional composition and energy value of the sampled meals were determined, as well as their FA composition (GC-FID). The findings indicated that the average energy value of the daily meals met the recommendations of national regulations, as well as the daily fat intake, with a total fat intake amounting to 24.5 g/day during both the autumn and winter seasons and 23.4 g/day in the spring season. The predominant FAs were SFAs; their average intake was 11.9, 13.4, and 12.1 g/day during autumn, winter, and spring, respectively. MUFA intake exhibited minor variations across the seasons, with mean intakes of 7.8, 7.6, and 7.4 g/day, respectively. The highest mean PUFA intake was observed during autumn (4.8 g/day), while the winter and spring seasons displayed intakes of 3.5 and 4.0 g/day, respectively. Furthermore, regarding the lipid quality indices, the highest average values of PUFAs/SFAs, considered desirable, were identified during autumn (0.51 ± 0.31), whereas the lowest values were observed in winter (0.32 ± 0.27). The atherogenicity (IA) and thrombogenicity (IT) indices consistently exceeded the recommended value of one across all seasons, indicating an unfavorable lipid quality. The lowest IA (1.07 ± 0.66) and IT values (1.11 ± 0.49) were recorded during autumn. These results have significant implications for establishing national guidelines and nutrition standards, particularly for preschool-aged children, aiming to enhance health outcomes and mitigate the burden of chronic diseases on the healthcare system in the Republic of Serbia. Improving the lipid quality of meals provided in kindergartens can contribute to these objectives.

Keywords: children; daily meal; lipid quality

Author Contributions: Conceptualization, L.T. and R.V.; methodology, L.T.; formal analysis, L.T.; investigation, M.P. and R.V.; data curation, L.T. and M.P.; writing—original draft preparation, R.V.; writing—review and editing, L.T. and S.B.; project administration, L.T.; funding acquisition, M.P. All authors have read and agreed to the published version of the manuscript.

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Development and Validation of a Food Frequency Questionnaire to Assess Polyphenol Intake and Its Association with Inflammation in the Portuguese Population: Study Plan [†]

Lizaveta Hilman , Cláudia Nunes Santos and Nuno Mendonça *



Citation: Hilman, L.; Santos, C.N.; Mendonça, N. Development and Validation of a Food Frequency Questionnaire to Assess Polyphenol Intake and Its Association with Inflammation in the Portuguese Population: Study Plan. *Proceedings* 2023, 91, 360. <https://doi.org/10.3390/proceedings2023091360>

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Abstract: Background: Conditions like inflammatory bowel disease (IBD) are lifelong inflammatory diseases that involve chronic inflammation of the gastrointestinal tract. Polyphenols are phytochemicals that are found in plant-based diets and possess beneficial health properties. Nutritional research has reported that a higher intake of polyphenols is associated with several health benefits. However, despite the health importance, measuring polyphenol intake in free-living subjects is challenging. There is a need to quantify polyphenol intake. Currently, there is a lack of validated food frequency questionnaires (FFQs) available for the assessment of polyphenol intake in the Portuguese population. Objectives: The purpose of this research is to (1) develop and validate a new food frequency questionnaire to assess the dietary polyphenol intake in the Portuguese population and (2) to use the validated FFQ to assess the relationship between the polyphenol intake and the inflammatory status in IBD patients. Hypothesis: Higher polyphenol intake is negatively associated with inflammatory biomarkers, such as calprotectin, C-reactive protein and inflammatory cytokines in IBD. Methods: To develop a semiquantitative FFQ consisting of max. 150 items by adapting the existing Portuguese FFQ and adding polyphenol-rich foods. Polyphenol data will be obtained from Phenol-Explorer, the USDA database, published literature and laboratory total phenol analysis. Dietary intake will be obtained from 100 adults. Population group—Portuguese, male and female. Validation will be calculated using the Wilcoxon signed-rank test, Spearman’s correlation and Bland–Altman statistics between 24-HRs and FFQs, corrected for attenuation from the within-person variation in the recalls. Discussion: A study will be conducted to assess the polyphenol intake using the validated FFQ in free-living IBD patients, and to measure the symptom severity and inflammatory biomarkers (C-reactive protein, inflammatory cytokines and calprotectin) to assess the association between the polyphenol consumption and the inflammatory status of IBD patients. Based on these data, patients will be stratified by low, medium or high polyphenol consumers and correlated with inflammation and symptom severity.

Keywords: FFQ; polyphenols; validation; 24-HR; inflammatory bowel disease; IBD; inflammation

Author Contributions: Conceptualization, C.N.S. and N.M.; Investigation, Writing—Original Draft Preparation, Writing—Review & Editing, L.H., C.N.S. and N.M.; Supervision, C.N.S. and N.M.; Funding Acquisition, C.N.S. All authors have read and agreed to the published version of the manuscript.

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Vitamin E and Cardiovascular Disease Risk Factors in Adults: Results from the Health Survey of São Paulo with Focus on Nutrition (ISA-Nutrition) [†]

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Abstract: Background and Objectives: Dietary vitamin E intake has high rates of inadequacies in Latin America, which may be potentially associated with increased cardiovascular risk. The objective of this study was to compare vitamin E intake and plasma vitamin E concentrations among cardiovascular disease risk factor (CVDR) groups from adults living in the urban area of São Paulo, Brazil. Methods: Data from 198 individuals aged 18 to 59 years were obtained from the 2015 Health Survey of São Paulo, a population-based cross-sectional study. Dietary intake was measured using two 24 h dietary recalls, and the usual dietary intake of vitamin E was calculated using the Multiple Source Method. Blood samples were analyzed to obtain plasma vitamin E concentration, serum lipid profile, insulin, and fasting glucose. Blood pressure, weight, and height were collected, and body mass index was calculated. CVDR was categorized as having three or more conditions: obesity, elevated systolic or diastolic blood pressure, dyslipidemia, and high fasting plasma glucose or insulin resistance. Student's *t*-test assessed comparisons between vitamin E values in groups of cardiovascular risk factors. Results: The mean intake of vitamin E was 6.43 mg/d, which was equivalent to 53.65% of the EAR reference values. Ninety eight percent of the sample had dietary inadequacy of vitamin E. Mean plasma α -tocopherol was 19.98 μ mol/L. The majority of the sample was female (57.6%), and 29.1% had three or more CVDR. Plasma values of α -tocopherol differed between individuals with three or more CVDR (mean: 21.86; SD: 9.16 μ mol/L) compared to those with less than three CVDR (mean: 29.24; SD: 7.30 μ mol/L), observing $t(196) = -1.87, p = 0.003$. There were no statistical differences in vitamin E intake between CVDR groups. Discussion: Our findings showed the severe inadequacy of vitamin E intake in the adult population of São Paulo. Moreover, individuals with higher numbers of CVDR had lower plasma values of vitamin E, which may indicate a necessity to increase vitamin E intake in individuals at higher risk. These results are particularly worrying, given the preventive function vitamin E intake may provide for individuals at higher cardiovascular risk.

Keywords: vitamin E; cardiovascular risk factors

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Author Contributions: Conceptualization, M.L.C., C.H.S. and R.M.F.; methodology M.L.C., P.V.F. and J.L.P.; formal analysis M.L.C. and P.V.F.; investigation, M.L.C. and C.H.S.; resources, M.M.R., F.M.S. and R.M.F.; writing—original draft preparation, M.L.C.; writing—review and editing, J.L.P., C.H.S., M.M.R., F.M.S. and R.M.F.; supervision, C.H.S., M.M.R., F.M.S. and R.M.F. All authors have read and agreed to the published version of the manuscript.

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The Association between Body Fluid Rate with Plasma Lipid Profile, Independent of Adiposity in Young Adults [†]

Xin Liu * , Junqi Li, Jiawen Xie, Guoqing Ma, Kun Xu and Jiaomei Yang



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Abstract: Objectives: Body water is fundamental in human metabolism. The current study aimed to evaluate the associations between body fluid rate (BFR) with plasma lipid profiles, including triglycerides, total cholesterol, and high-density lipoprotein (HDL)/low-density lipoprotein (LDL) cholesterol, among apparently healthy young Chinese adults. Methods: The study subjects were from the phase 1 sample of the ‘Carbohydrate Alternatives and Metabolic Phenotypes’ study. After excluding those lacking blood samples, a total of 95 subjects with an average age of 22.6 years were included in the analysis. Total body water (TBW) and body fluid rate (BFR) were measured using bioelectrical impedance analysis (TANITA, BC-420). General linear regression was used to evaluate the associations between body fluid rate with plasma lipid profiles. Results: The mean (SD) of TBW was 39.7 (4.7) kg and 26.8 (2.2) kg for males and females, respectively, while the mean (SD) of BFR was 55.8 ± 3.1 and 50.4 ± 2.1 for males and females, respectively. After adjusting for age, sex, education attainment, smoking status, alcohol drinking habits, and physical activity level, negative associations (β , SE) were observed between BFR with triglycerides (−0.06, 0.02, $p < 0.001$) and LDL cholesterol (−0.07, 0.02, $p = 0.003$), while no significant associations were detected for total cholesterol (−0.06, 0.03, $p = 0.052$) and HDL cholesterol (0.02, 0.01, $p = 0.074$). These associations were not substantially changed with further adjustment of body mass index. In the stratified analysis by gender, the direction of the associations was not changed, but BFR was negatively associated with LDL cholesterol (−0.09, 0.04, $p = 0.049$) in males, and with triglycerides (−0.05, 0.02, $p = 0.043$) in females only. Conclusions: In apparently healthy young Chinese adults, BFR was negatively associated with triglycerides and LDL cholesterol, independent of body adiposity level.

Keywords: body fluid rate; lipid profile; adiposity

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Effects of Time-Restricted Hypocaloric Mediterranean Diet in Patients with Non-Alcoholic Fatty Liver Disease: Preliminary Data from the CHRONO-NAFLD Project [†]

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Abstract: Background and objectives: Non-alcoholic fatty liver disease (NAFLD) is spreading at alarming rates, representing a serious public health problem, and it is the most common cause of chronic liver disease. This study aims to evaluate the effects of time-restricted feeding (TRF) along with a hypocaloric Mediterranean Diet (MD) on body weight and biochemical indices. Methods: This 12-week, open-label, randomized controlled trial [NCT05866744] consists of three interventional groups following a personalized diet (1500–2100 kcal/day): control group (MD without time restriction), early 14:10 TRF, and delayed 14:10 TRF. Anthropometric measurements and biochemical analyses are carried out at baseline and 12 weeks. Results: We recruited sixty NAFLD patients with a mean body mass index (BMI) of 31.8 ± 0.8 kg/m² and a mean age of 51.05 ± 2.74 years, out of whom twenty-one (10 males, 47.6%) have completed the ongoing trial (control $n = 7$, early TRF $n = 6$, delayed TRF $n = 8$). There was no difference in body weight between the groups at 12 weeks, but each group lost significant body weight compared to baseline (control: 6.3%, $p = 0.015$; early and delayed TRF: 8%, $p = 0.004$, and $p = 0.001$, respectively). The three groups differed in total cholesterol, triglycerides, and low-density lipoprotein cholesterol levels at 12 weeks. Significant decreases in BMI, waist circumference, hip circumference, fat mass, and systolic and diastolic blood pressure were observed in all groups. Additionally, in the control group, there was a decrease in fasting insulin, homeostatic model assessment for insulin resistance (HOMA-IR), alanine aminotransferase, and controlled attenuation parameter derived from elastography; while in the early TRF group, there was a tendency for lower glycated hemoglobin A1c. Finally, in the delayed TRF group, fasting glucose, gamma-glutamyl-transferase, and alkaline phosphatase were improved compared to baseline. There was no difference in pleasure rate between the three interventions at baseline or 12 weeks. Discussion: These preliminary data show that 14:10 TRF led to clinically significant weight loss (>5%), mainly via fat mass loss, and to an improved lipid profile, regardless of the time restrictions placed on food intake. Consequently, TRF could be an alternative weight loss strategy for individuals with NAFLD.

Keywords: non-alcoholic fatty liver disease; time-restricted feeding; Mediterranean diet; glucose metabolism; weight loss

Author Contributions: Conceptualization, S.T., E.P., E.C. and K.-A.P.; methodology, research, and data analysis, S.T.; volunteers' assessment; S.T., E.C., T.B. and A.N.; original draft preparation, S.T.; writing—review and editing, S.T., E.P. and E.C. All authors have read and agreed to the published version of the manuscript.

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Can Planetary Health Mean Population Health? Higher Adherence to the EAT-Lancet Reference Diet Is Inversely Associated with Mortality in a UK Population of Cancer Survivors [†]

Nena Karavasiloglou ^{1,2,3,*} , Giulia Pestoni ^{1,4} , Anika Knuppel ⁵, Keren Papier ⁶ , Aedin Cassidy ⁷,
Tilman Kühn ^{7,8,9} and Sabine Rohrmann ^{1,2} 



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Abstract: Background and Objectives: Advancements in treatment and care, as well as early detection, have contributed to an increase in cancer survival rates. However, limited evidence exists on the optimal diet that should be followed by people after receiving a cancer diagnosis and how it may affect their survival outcomes. Recently, the EAT-Lancet Commission on Food, Planet, Health proposed the “planetary health diet” as a diet within the planetary boundaries. We aimed to investigate, for the first time, the association between adherence to the EAT-Lancet reference diet and mortality in cancer survivors. Methods: Using data from the UK Biobank cohort, we created a sub-population of cancer survivors, based on cancer-registry diagnoses. Data from the UK Biobank’s Touchscreen questionnaire were used to develop a score reflecting adherence to the EAT-Lancet reference diet. Cox proportional hazards regression models were fitted to assess the association of the EAT-Lancet reference diet score with all-cause, cancer, and cardiovascular mortality in cancer survivors. Results: Better adherence to the EAT-Lancet reference diet was inversely associated with all-cause and cancer mortality, while mostly null associations were seen for cardiovascular mortality. Stratified analyses using potential effect modifiers led to largely similar results. Discussion: Our findings support the notion that the adoption of the EAT-Lancet reference diet has the potential to be beneficial for cancer survivors. Additional studies are needed in this specific population to further assess their post-diagnostic needs as well as the perceived barriers to the adoption of healthy lifestyle habits.

Keywords: EAT-Lancet; cancer; survivors; mortality; UK Biobank cohort; prospective

Author Contributions: Conception and design: N.K., G.P., A.K., K.P., A.C., T.K. and S.R. Data acquisition: N.K. and S.R. Analyzing the data: N.K., T.K. and S.R. Interpretation of the data: N.K., G.P., T.K. and S.R. Drafting the manuscript: N.K. Critically revising the manuscript: N.K, G.P., A.K., K.P., A.C., T.K. and S.R. All authors have read and agreed to the published version of the manuscript.

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Characterising Diurnal and Irregularity Eating Patterns and Their Relationship with Obesity in the Italian Population in the INRAN-SCAI 2005–2006 Nutrition Survey †

Luigi Palla *  and Laura Lopez Sanchez



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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and Objectives: Late food intake has been linked to weight gain while early meals have been associated with weight loss and maintenance. However, the impact of temporal (diurnal) eating patterns summarising the time of food intake throughout the day and the eating time irregularity across surveyed days has been less investigated. INRAN-SCAI is a cross-sectional nutrition survey conducted in 2005–2006 in a representative sample of the Italian population, collecting diet diaries over 3 days, including a questionnaire with socio-demographic and anthropometric variables. We aimed to characterise diurnal and irregularity eating patterns (DIEPs) and investigate their association with BMI/obesity in Italian adults (18–64 ys). Methods: We derived the DIEPs by Principal Component Analysis (with covariance matrix) jointly on indices of average and irregularity of energy intake using the reduced six time intervals corresponding to common eating time slots in Italy. The first five DIEPs explained 93% of the total variance, with the first DIEP score increasing with energy intake at main meals. A mixed-effect model with random intercept accounting for the correlation within household (ICC) was applied including only adults (complete case analysis $n = 2022$), with BMI as outcome, the main DIEPs as exposures and a set of confounders identified by a causal diagram. Results: The model resulted in a positive association of BMI with the first DEP ($b = 0.75$ per 100% score, $p = 0.009$; ICC = 0.195, $p < 0.0001$). A positive significant association also resulted between BMI and the third DIEP (10% variance) whose score increased with energy intake at snack times outside main meals ($b = 0.89$ per 100% score, $p = 0.013$) and with the fifth DIEP (6.4% variance), which mainly captured food intake at night and irregularity of intake at night ($b = 0.34$ per 100% score, $p = 0.028$). Discussion: Despite the limitations of a cross-sectional design, this study indicates that in the Italian adult population BMI tended to increase not only with large energy intake at main meals and at snack times but also with energy intake and irregularity of intake at night. This is in line with recent findings in the British population, indicating the relevance of surveying and modifying DIEPs, beside average daily intake, for obesity management.

Keywords: chrononutrition; obesity; nutrition survey; principal component analysis

Author Contributions: Conceptualization, L.P.; methodology, L.P.; software, L.P. and L.L.S.; formal analysis, L.P. and L.L.S.; data curation, L.L.S.; writing—original draft preparation, L.P. and L.L.S.; writing—review and editing, L.P.; supervision, L.P.; project administration, L.P.; funding acquisition, L.P. All authors have read and agreed to the published version of the manuscript.

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Dietary Habits as Acne Trigger [†]

Esma Karahmet Farhat ^{1,*}, Ines Banjari ¹  and Tamara Jovovic´ Sadikovic´ ²



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Abstract: Acne is the most common skin disease in the world and reason to visit a dermatologist. It affects more than 95% of adolescents, 3% of men and 12% of adult women. Exposure to stress, fast lifestyles, hormonal imbalances, gut dysbiosis, associated diseases, and eating habits can significantly contribute to the worsening of acne. The modern concept of acne treatment is holistic, and pays significantly more attention to the human microbiota than before. A properly balanced diet provides nutrients that the human body needs to function and reduces the appearance of acne. Significant differences between adults and adolescents have been observed in the daily intake of PUFAs and calcium, and nearly significant differences have been reported for vitamin B intake. Adults consume a more balanced diet compared to adolescents. **Subjects and methods:** Using a questionnaire, data were collected (anthropometry, general health status, comorbidities, use of medicines and supplements, dietary and lifestyle habits; additional data on women and the menstrual cycle) from 60 dermatological patients of both genders, aged 15–46 years, from Sarajevo. A significance level of 0.05 was used. Analysis was performed using Statistica software (version 14.0, StatSoft Inc., Tulsa, OK, USA). The research aimed to determine whether and how dietary habits influence the severity, etiology, and incidence of acne in both genders. **Results and Discussion:** The average BMI of the patients was 22.4 ± 3.4 kg/m². It was found that men have less acne, but a more severe form. In total, 53% of patients had a positive family history of acne. The majority of acne has an unknown etiology (41.7%), followed by bacterial (30%) and hormonal (28.3%) causes. Hormonal acne was present exclusively in women. The average compliance of the patient’s diet with the principles of the Paleo diet was 54%, and the respondents most rarely consumed fish, and very often sweets, salty and fast food. Significant differences between the adults and adolescents were found in the daily intake of PUFAs ($p = 0.023$) and calcium ($p = 0.049$), and nearly significant differences in vitamin B intake (pvit B9 = 0.059). Supplements were taken daily by 82% of the respondents, most often including herbal teas (67%), vitamin C (40%), and vitamin D (38%). Whey protein was consumed by 10% of the patients, and it has been confirmed that this can be a trigger for the appearance of acne. **Conclusions:** A positive correlation was found between the number of meals and the severity of acne. Patients with fewer meals per day had a mild form of acne.

Keywords: acne; adolescents; adults; dietary habits; supplements

Author Contributions: Conceptualization, methodology, software, validation, formal analysis, I.B. and E.K.F.; investigation, T.J.S.; resources, data curation, writing—original draft preparation, E.K.F.; writing—review and editing, I.B.; visualization, E.K.F.; supervision, project administration, I.B. All authors have read and agreed to the published version of the manuscript.

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An Animal Model to Investigate Postprandial Metabolism [†]

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Abstract: Background and Objectives: Bile acids (BA) are recognized as metabolic integrators that participate in the regulation of energy metabolism and inflammation. Their concentration in the plasma increases several-fold after a meal. The postprandial period is characterized by physiological changes to accommodate the alterations in nutrient availability and a systemic inflammatory response. An animal model would be an important tool to investigate postprandial metabolism, but there is no fully characterized model, and it is uncertain whether human responses to a meal can be reproduced in animals. This study aimed to characterize an animal model for investigating postprandial metabolism and inflammation, with a focus on the role of BA in the modulation of postprandial inflammation. Methods: Changes in plasma BA levels and hepatic cytokine concentrations were investigated in male

Sprague-Dawley rats ($n = 50$) at different time points after the ingestion of a high-fat meal (fasting, 60, 120, 180, and 300 min). Results: Plasma BA levels were quantified using liquid chromatography-mass spectrometry (LC-MS/MS), and hepatic inflammatory marker content was assessed using Western blotting. As a result, we observed that unlike humans, rats showed a predominance of unconjugated BA (~70%) both during fasting and throughout the postprandial period in the plasma, with cholic acid being the most abundant species (~36%). On the other hand, rats exhibited a postprandial inflammatory response with a temporal resolution like that observed in humans. In the liver, two hours after meal ingestion, the content of Toll-like receptor 4 (TLR-4) was 30% higher than in the fasting state ($p = 0.0071$). Discussion: TLR-4 is a receptor that interacts with intracellular adaptors to activate tumor necrosis factor κ B (NF- κ B), which also increased in the liver three hours after meal ingestion ($p = 0.0208$). Increased hepatic mRNA expression of interleukin 6 (IL-6) and interleukin 1β (IL- 1β) was also observed at 60 min. Preliminary analysis demonstrated that rats exhibit postprandial inflammation in the liver and may constitute a valid experimental model to investigate postprandial alterations also observed in clinical trials.

Keywords: bile acids; post-prandial; energy metabolism; meta-inflammation; metabolomics

Author Contributions: Conceptualization, L.R. and J.F.; methodology, J.F. and K.H.; formal analysis, L.R., C.M.D.-P. and T.M.; investigation, L.R., C.M.D.-P., A.D.V. and V.B.M.; resources, J.F. and K.H.; writing—original draft preparation, L.R.; writing—review and editing, L.R. and J.F.; supervision, J.F. and K.H. All authors have read and agreed to the published version of the manuscript.

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Markers of Dysmetabolism Revealed Using a Dietary Challenge and Dry Blood Spots in a Remotely Executed Clinical Trial [†]

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Abstract: Background and Objectives: The physiological changes that take place after the ingestion of a meal are largely controlled by insulin and can reflect changes in the response to this hormone. Different studies have reported metabolic differences among groups of subjects in the postprandial state, while failing at detecting differences in the fasted state. Dry blood spots (DBS) are a non-invasive tool for sampling and storing small volumes of biological fluids, useful in biomarker discovery studies or the analysis of responses to interventions. The aim of this study was to identify markers of dysregulated glucose postprandial metabolism in a clinical study conducted remotely, using DBS as a sampling strategy. Methods: 100 males and females (18–60 y.o., BMI: 18.5–34.9 kg/m²) went through a dietary challenge based on the intake of an energy-dense meal (75 g glucose, 60 g canola oil and 20 g casein) and blood sampling (as DBS) at 0, 30, 60, 90, 120 and 150 min. Capillary glycaemia was monitored using a portable glucometer. DBS samples were analyzed in an untargeted metabolomic platform using gas chromatography coupled to mass spectrometry. Results: The outcomes of the study confirm the viability of the remotely executed clinical study. Performing the dietary challenges at the homes of the study subjects did not interfere with the quality of the data collected. The subjects were sorted according to glucose AUC and divided into two groups. The blood levels of markers of insulin resistance such as branched-chain amino acids and tyrosine were increased in the subjects with the larger glucose AUC. The concentration of metabolites associated with glucose metabolism (monosaccharides, lactate and Krebs cycle metabolites) were also increased in the blood of individuals with higher AUC, in comparison to those with lower AUC values. Moreover, 30 other unidentified metabolites also displayed higher concentrations in the DBS collected from individuals with larger AUC of glucose, indicating a number of compounds with marker quality that remain to be identified. Discussion: This is the first clinical study that employed DBS as a sampling strategy during a dietary challenge and successfully described a metabolic signature of glucose metabolism dysregulation.

Keywords: metabolomics; GC-MS; DBS; metabolism; postprandial

Author Contributions: Conceptualization, J.F.; methodology, J.F., T.M., K.H. and E.D.S.A.; software, K.H.; formal analysis, T.M. and J.F.; investigation, S.G.D.; resources, J.F. and K.H.; data curation, T.M., J.F. and S.G.D.; writing—original draft preparation, C.M.D.-P. and R.M.C.B.; writing—review and editing, J.F.; supervision, J.F.; project administration, R.M.C.B., S.G.D. and E.D.S.A.; funding acquisition, J.F. and K.H. All authors have read and agreed to the published version of the manuscript.

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Effect of Fermented Food Products as Vitamin K Dietary Sources on the Development of Atherosclerotic Lesions in ApoE/LDLR^{-/-} Mice[†]

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Abstract: The term vitamin K refers to a group of similarly structured fat-soluble compounds. One of the vitamin K forms is phyloquinone, known as vitamin K1. The main nutritional sources of vitamin K1 are green, leafy vegetables like kale, beetroot, spinach and broccoli. Other forms of vitamin K are menaquinones (vitamin K2) that can further be divided into a few subtypes depending on the number of isoprenoid residues in the side chain (MK-n). Besides MK-4, bacteria synthesize all menaquinones. As such, the main dietary sources of vitamin K2 are natto, dairy (especially fermented products, e.g., cheese), meat and eggs. Until recently, vitamin K was associated with the regulation of the coagulation system. Interest in the biological activity of these compounds increased once it was discovered that vitamin K2 affects the processes of the calcification of both bones and soft tissues. Vitamin K can reduce oxidative stress and inflammation. The objective of the present study was to verify the hypothesis about the effectiveness of dietary vitamin K2 as an anti-atherosclerotic agent. An in vivo experiment on ApoE/LDLR^{-/-} mice was conducted to verify this hypothesis. Two month-old mice were fed AIN-93G modified diets containing vitamin K-rich products, i.e., natto, cheese (Munster), sauerkraut and synthetic vitamin K2 MK-7 (100 µg/kg b.w./day) for 8 weeks. The body weight, weight of organs and glucose concentration were determined. Blood was taken and the aorta dissected. The investigation included both the area of lesions and biochemical parameters such as lipid profile. Quantification of the atherosclerotic area in entire aorta was performed by an en face method. The lipid profile was determined automatically by ABX Pentra 400 (Horiba Medical, Kyoto, Japan). The concentration of vitamins K was determined using UHPLC-MS/MS technique in faeces. Body weights of mice fed MK-7 and Munster were significantly decreased compared to Control (respectively, 20.01 and 19.98 vs 21.45 [g]). Liver's weight of mice fed Munster was significantly increased in comparison to other groups (5.70 vs 4.53 [g/100g] in Control). Glucose concentration was unchanged. Significant changes in plasma lipid profile of mice fed modified diets, especially in groups fed Munster and Sauerkraut, were observed. Total cholesterol and LDL concentrations were significantly increased in Munster and Sauerkraut compared to Control (respectively, for TC 20.45 and 19.80 vs 15.95 [mmol/L]; for LDL 17.15 and 11.94 vs 7.85 [mmol/L]). Moreover, TAG level was significantly increased in Sauerkraut in comparison to Control (2.87 vs 2.23 [mmol/L]). The main forms of vitamin K identified in mouse faeces were menaquinones MK-6. Nutritional factors with an alleviating effect on the development of atherosclerotic plaques are still being investigated.

Keywords: vitamin K; fermented products; atherosclerosis; ApoE/LDLR^{-/-} mice

Author Contributions: Conceptualization, M.F.-Z. and R.B.K.; methodology, M.F.-Z., I.C.-C. and A.K.; formal analysis, H.A.H. and A.S.; investigation, H.A.H.; resources, B.C.; data curation, H.A.H.; writing—original draft preparation, M.F.-Z.; writing—review and editing, R.B.K.; supervision, R.B.K.; project administration, M.F.-Z.; funding acquisition, M.F.-Z. All authors have read and agreed to the published version of the manuscript.

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N-3 Polyunsaturated Fatty Acid Profile Is Altered in Pregnant Women with Different Allergic Diseases [†]

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Abstract: The incidence of allergic problems has notably increased in recent decades, affecting approximately 20% of the population and becoming a public health issue. Some studies have suggested that asthma and atopy could result from an increased dietary intake of n-6 polyunsaturated fatty acids (PUFA) and a decreased intake of n-3 PUFA. During pregnancy, the fetus depends on the transplacental transfer of n-3 PUFA from maternal circulation, which implies that maternal lipid profile alterations might predispose to allergy onset during infancy and childhood. The aim of this study was to evaluate the circulating fatty acid profile in pregnant women with allergic problems as well as in fetal plasma at birth. Plasma samples from 73 allergic and 179 healthy pregnant women as well as cord venous plasma were collected at delivery in the NELA cohort (Murcia, Spain). Maternal allergy was diagnosed according to the symptoms and via a positive skin prick test. The fatty acid profile was determined by gas chromatography. The allergic mothers had a lower percentage of n-3 PUFA in the plasma compared to the healthy ones (Allergic: 4.06 ± 0.15 vs. Control: 4.66 ± 0.11 , $p = 0.002$), especially in those with asthma or food allergies. This contributed to a significantly higher n-6/n-3 PUFA ratio in women with allergies (Allergic: 9.45 ± 0.31 vs. Control: 8.28 ± 0.20 , $p = 0.002$), mainly asthma and food allergies, which was indicative of a proinflammatory status. The same tendency was observed in women affected by atopic dermatitis ($p = 0.094$). In cord blood, despite the fact that there were no differences in the n-6/n-3 PUFA ratio between the groups, the fetuses born from allergic mothers showed a tendency towards lower n-3 PUFA content compared to those born from healthy mothers (Allergic: 5.63 ± 0.19 vs. Control: 6.17 ± 0.21 , $p = 0.093$). In conclusion, allergy led to a decreased n-3 PUFA and an increased n-6/n-3 ratio fatty acid profile in pregnant women at delivery, especially in those affected by asthma and food allergies. The same tendency was observed in cord plasma. A higher n-3 PUFA consumption could be desirable in women with allergic diseases in order to improve their lipid profile and proinflammatory status and their offspring's health.

Keywords: fatty acid; pregnancy; allergy; omega-3

Author Contributions: Conceptualization, A.G. and E.L.; methodology, A.G., A.M.E.-M., M.S.-M., V.O. and M.D.M.-R.; formal analysis, A.G. and E.L.; investigation, A.G., A.M.E.-M. and M.S.-M.; resources, L.G.-M. and E.L.; writing—original draft preparation, A.G. and E.L.; writing—review and editing, A.G., L.G.-M. and E.L.; supervision, E.L.; project administration, L.G.-M.; funding acquisition, L.G.-M. and E.L. All authors have read and agreed to the published version of the manuscript.

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Diet-Specific Multi-Omics Markers Associated with Metabolic Health Benefits Can Be Determined in Vegan Population [†]

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Abstract: Background and objectives: Diet is one of the fundamental factors that not only determines metabolic health but also shapes the gut microbiome and serum metabolome (MIME). Plant-based diets are associated with potential health benefits, but their effect on MIME remain to be elucidated. We sought to determine whether diet-dependent markers explaining the observed health benefits of a vegan diet could be identified in the MIME of vegans from different geographic regions. Methods: Lean, healthy vegans ($n = 100$) and omnivores ($n = 73$) with comparable BMI from two geographical regions (Czech Republic, Northern Italy) participated in the cross-sectional study. Based on their clinical characteristics and serum markers, we investigated their glucose and lipid metabolism and used an integrated multi-omics approach (16S rRNA sequencing, metabolomics and lipidomics profiling) to identify country- and diet-specific MIME markers. Results: Czech and Italian vegans exhibited more favorable lipid profile parameters compared to omnivores characterized by decreased serum concentrations of sphingomyelins, ceramides, cholesterol esters, and lipid species containing saturated fatty acid. Using a machine learning approach, we were able to discriminate between vegans and omnivores based on separate omics datasets, regardless of country of origin. By combining all MIME features, we were able to identify a vegan diet-specific multi-omics signature that allows for the classification of vegans and omnivores with high accuracy. Most of the vegan-specific variables were associated with favorable indices of lipid and glucose metabolism, inflammation, or body weight. Discussion: Most of the MIME markers that are down-regulated in vegans are predominantly associated with adverse health outcomes, whereas those that are up-regulated are associated with a healthy phenotype and a low risk of non-communicable diseases. Our findings support the potential use of a healthy plant-based diet in the treatment of metabolic disorders.

Keywords: vegan diet; multi-omics; lipidomics; gut microbiota; NCDs

Author Contributions: M.C., A.N., J.G. and G.F. designed and initiated the study. M.C., A.O., M.H. and T.A. drafted the abstract. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Sequencing data are available in the European Nucleotide Archive database under the accession number PRJEB43938. The publication of the dietary data as well as metabolomics data is not possible, as it was not covered by the participants' informed consent used for the study. However, pseudonymized data will be made available by the corresponding authors upon reasonable request.

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Variant of SNP 1799930 Identifies the Protective Character of High Metabolizing of Xenobiotics in Individuals with Overweight and Obesity [†]

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Abstract: Background and Objectives: Enzymes involved with acetylation capacity affects the metabolism of several xenobiotics that can be deposited in adipose tissue and hinder weight loss, leading to obesity. Our aim was to identify single nucleotide polymorphisms (SNPs) related to the xenobiotic's metabolism and to associate such with the serum levels of heavy metals in an individual with excess body weight. Methods: The sample was selected at the Ribeirão Preto Medical School at the University of São Paulo, Brazil. Genotyping arrays were performed with 23 SNPs.

Quality control and imputation steps were applied using the functions in the package 'snpReady' (CRAN) and 'imput' (Bioconductor). Results: This study selected 189 individuals of mixed ethnicity of both sexes, with a mean age of 42.2 ± 12.9 years and a mean BMI of 45.1 ± 11.4 kg/cm². From the cluster of 23 evaluated SNPs, we observed a higher frequency of SNP 1799930 in the NAT2 gene (N-acetyltransferase). The genotypes were correlated to the serum levels of different metals. We observed that individuals homozygous for the mutant allele (AA), called fast metabolizers, had lower levels of aluminum (Al) (51.4 ± 18.9 µg/L) compared to those considered slow metabolizers (GG) (64.0 ± 37.2 µg/L; $p = 0.02$). No difference was observed when compared with heterozygosity (AG). Furthermore, the BMI of fast metabolizers (48.7 ± 12.8 kg/cm²) was higher than the slow metabolizer individuals (45.9 ± 10.4 kg/cm²; $p < 0.05$). Discussion: Fast metabolizers seem to have a greater Al metabolism only in homozygosity, that is, the dose-dependent gene, to exert its effect. Interestingly, the presence of the AA genotype is associated with a higher BMI, suggesting that larger studies should be carried out investigating the deposition of metals in adipose tissue.

Keywords: aluminum; mutant allele; SNP; obesity; xenobiotics

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Are There Differences in Cytokine Profiles between Vegetarians and Omnivores? [†]

Marta Despotović , Slavko Mojsilović , Ivana Šarac * , Jasmina Debeljak Martac'ić , Gordana Petrović Oggiano , Petar Jovanović and Marija Takic' 



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background: According to scientific evidence, plant-based diets like vegetarian diets may be protective against chronic inflammatory disease. To date, the association of vegetarian nutrition with circulation CRP levels has been noticed and confirmed using meta-analyses. However, further studies are needed to clarify the possible associations between other inflammation markers and vegetarian diets since such data are lacking. Objective: in this study, we investigated the serum levels of a panel of cytokines in vegetarians compared to omnivores by performing flow cytometry quantification of 13 cytokines using a commercially available LEGENDplex bead-based immunoassay kit. Methods: This study included apparently healthy subjects: 80 omnivores and 80 subjects who had been on a vegetarian diet for at least 2 years (67 vegans and 13 lacto-ovo vegetarians). Omnivores and vegetarians were matched for gender, age, and body mass index (BMI). Results: Statistically significant lower circulating levels of IFN- γ ($p < 0.01$), TNF- α ($p < 0.05$), IL-6 ($p < 0.05$), IL-8 ($p < 0.05$), IL12p70 ($p < 0.05$), and IL-17A ($p < 0.01$) were found in vegetarians compared to omnivores. We also observed a trend for similar differences in IL-10 levels ($p = 0.085$). The levels of IL-1 β , IFN- α 2, MCP-1, IL-18, IL-23, and IL-33 did not statistically differ between the studied groups. Discussion: This study shows the link between plant-based diet and reduced levels of pro-inflammatory cytokines. In conclusion, the levels of some pro-inflammatory cytokines might be influenced by a plant-based diet, suggesting that this type of diet leads to the modulation of the cytokine network and inflammation responses.

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Keywords: cytokines; immunity; inflammation; vegetarian; diet

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Comparative Analysis of Fatty Acid Profiles in Erythrocyte Membranes in Vegetarians Compared to Omnivores [†]

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Abstract: Background: The fatty acid profiles in cellular membranes can be influenced by many endogenous and external factors, including diet. They are also associated with numerous metabolic and health conditions, including cardiovascular diseases and inflammation. Objective: This study provides a comparative analysis of the fatty acid profiles in subjects on vegetarian and omnivorous diets. Methods: The study enrolled 152 apparently healthy subjects, comprising 78 omnivores and 74 individuals who had followed a vegetarian diet for a minimum of 2 years, including 61 vegans and 13 lacto-ovo vegetarians. The subjects in the omnivore and vegetarian groups were matched by gender, age, and body mass index (BMI). The composition of the fatty acids in their erythrocyte membranes was determined using gas–liquid chromatography and presented as a percentage of total fatty acids. Results: The study revealed statistically significant differences in the fatty acid profiles: vegetarians had higher levels of oleic acid (OA, 18:1 n-9) ($p < 0.001$) and linoleic acid (LA, 18:2 n-6) ($p < 0.001$), while at the same time having lower levels of gamma-linolenic acid (GLA, 18:3 n-6) ($p < 0.05$), eicosapentaenoic acid (EPA, 22:5 n-3) ($p < 0.001$), docosapentaenoic acid (DPA, 22:5 n-3) ($p < 0.001$), docosahexaenoic acid (DHA, 22:6 n-3) ($p < 0.001$), and total omega-3 polyunsaturated fatty acid (PUFA) ($p < 0.001$) and a lower omega-3 index ($p < 0.001$). Additionally, they had lower omega-3 to omega-6 PUFA ($p < 0.001$); EPA/arachidonic acid (ARA, 20:4 n-6) ($p < 0.001$); and DHA/ARA ratios ($p < 0.001$). The activity of delta-6 desaturases (D6D), estimated as the GLA/LA ratio, was higher in the omnivores ($p < 0.005$), while the activity of elongase 2 (ELOV2), estimated as the DPA/EPA ratio, was higher in the vegetarians ($p < 0.005$). Most of the differences presented in both vegans and vegetarians, except for GLA and D6D, where differences were observed only in vegans compared to omnivores. Discussion: This study highlights the distinct fatty acid profiles associated with vegan, lacto-ovo vegetarian, and omnivorous diets, suggesting their differential impact on inflammation, disease protection, and overall health. Understanding the implications of the fatty acid profiles within these dietary patterns can be used for personalized nutritional recommendations and supplementation for individuals adhering to specific dietary lifestyles.

Keywords: fatty acids; omega 3; vegan; vegetarian; diet

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Impact of Nutrition Intervention on Mental Health Outcomes in Adults: Preliminary Evidence from a Systematic Review and Meta-Analysis [†]

Lynsey Montgomery ^{*}, Helene McNulty, Mary Ward , Shane Gordon , Michelle Clements, Leane Hoey

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Mental health disorders are the leading cause of ill health and disability in adults, with depression and anxiety being the most prevalent. Emerging evidence indicates roles for specific nutrients—particularly, omega-3 fatty acids, vitamin D, folate, and the metabolically related B vitamins (B12, B6 and riboflavin)—in protecting against depression and anxiety, but the evidence is conflicting. The aim was to conduct a systematic review and meta-analysis investigating the effect of intervention with nutritional factors on mental health outcomes in adults. Methods: Searches were conducted using the following electronic bibliographic databases: MEDLINE, EMBASE and PsycINFO. Inclusion criteria were randomised controlled trials (RCTs) or controlled dietary interventions, participants aged ≥ 18 years, study duration ≥ 12 weeks and depression or anxiety outcome measures. The risk of bias and quality of the evidence were assessed using the Cochrane Risk of Bias 2 tool and the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) framework, respectively. Results: A total of 83 studies met the inclusion criteria, of which 73 were included in the meta-analysis. Regarding the role of specific nutrients in depression, RCTs with B vitamins (standardised mean difference, SMD, -1.91 95% CI -3.69 , -0.13) and zinc (SMD -0.59 95% CI -0.86 , -0.30) indicated significant benefits in reducing depression. Although no overall effect of vitamin D intervention in reducing depression for studies was found, subgroup analysis showed a beneficial effect of 12-week duration (SMD -0.29 95% CI -0.57 , -0.01), while no significant effect of omega-3 fatty acid intervention was observed (SMD -0.47 95% CI -0.98 , 0.04). RCTs with vitamin D indicated beneficial effects in reducing anxiety (SMD -0.69 95% CI -1.27 , -0.11). No significant effect of omega-3 fatty acids on anxiety was shown, while there were insufficient RCTs with B vitamins and zinc in relation to anxiety. Discussion: This preliminary analysis demonstrated a potential role for B vitamins, vitamin D and zinc, but no benefit of intervention with omega-3 fatty acids, on depression. Vitamin D may play a role in reducing anxiety, whereas omega-3 does not. Confirmation of these preliminary findings is required from new RCTs with relevant nutrients.

Keywords: mental health; depression; anxiety



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Replacing Part of Maltodextrin with Galactose in Early Life Diet Results in an Improved Body Composition and Energy Metabolism in a Mouse Model [†]

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Abstract: Background: Lactose, a disaccharide of glucose and galactose, is the primary carbohydrate found in milk. Recently, there has been an increased demand for low lactose/lactose-free infant formulas. Maltodextrin (MDX) is a popular, alternative carbohydrate source in these formulas, yet the (long-term) health effects of consuming maltodextrin in early life are unclear. Previously, consuming galactose (partly replacing glucose) in a postweaning diet was shown to improve metabolic health in mice. Objective: To investigate the effects of partly replacing MDX with galactose in post-weaning diets on body composition and energy metabolism. Methods: Weaned, individually housed female C57BL/6JRcHsd mice received isocaloric diets (in a dough ball format) with different carbohydrate profiles for three weeks (postnatal day (PN)21–PN42). GLUGAL (lactose mimic, n = 13) contained 15.7 en% glucose, 15.7 en% galactose and 14.9 en% MDX, and GAL (n = 12) contained 15.7 en% galactose, no glucose and 30.6 en% MDX. MDX (n = 13) contained 38.4 en% MDX and 7.9 en% glucose. Energy metabolism was assessed via indirect calorimetry from PN40–PN42. At PN42, all mice were challenged with a 40 en% high-fat diet (HFD) until PN105. Body composition was measured weekly using Echo-MRI. At PN105, fasted (4 h) mice were sacrificed for serum and tissue analysis. Results: At PN42, mice in both galactose-fed groups (GLUGAL and GAL) had a significantly lower body weight, fat mass and relative fat mass compared with the MDX group ($p < 0.0001$). The respiratory exchange ratio was significantly lower in both galactose-fed groups compared with the MDX group ($p < 0.05$), suggesting lower carbohydrate oxidation and thus higher relative fat oxidation levels. In parallel, both galactose-fed groups showed lower energy expenditure ($p < 0.05$). Discussion: The GAL mice were similar to the GLUGAL (lactose mimic) mice in terms of body weight, composition and energy metabolism, while being significantly different from the MDX group at PN42. These findings suggest an improvement of body composition and energy metabolism when replacing MDX with galactose. This study is the first to compare the effects of replacing part of MDX with galactose in early life and reinforces the impact of the type of carbohydrates on metabolic outcomes.

Keywords: galactose; maltodextrin; body composition; energy metabolism; lactose free; early life; post-weaning

Author Contributions: Conceptualization, M.R. and E.M.V.S.; methodology, M.R., L.S., E.M.V.S.; investigation, P.S., M.B.-G.; formal analysis, P.S.; writing—review and editing, M.R.; supervision, E.M.V.S. All authors have read and agreed to the published version of the manuscript.

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The Role of Chronotype on Body Composition, Eating Habits and Cardiometabolic Risk Parameters in a Sample of Overweight/Obese Subjects [†]

Sofia Lotti * , Monica Dinu , Marta Tristan Asensi , Giuditta Pagliai , Antonia Napoletano, Barbara Colombini  and Francesco Sofi 



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: In recent years, the role of chronotype in obesity has been hypothesised, as subjects with an evening chronotype showed worse eating habits. However, the results are still limited and conflicting. The aim of the study is therefore to assess differences in body composition, eating habits and cardiometabolic parameters according to chronotype in a sample of overweight/obese subjects. **Methods:** Overweight/obese subjects (BMI > 25 kg/m²) aged 18–65 years were recruited at the Clinical Nutrition Unit of Careggi University Hospital, Florence, from March to April 2023. The chronotype was defined through the Morningness–Eveningness Questionnaire (MEQ). Each participant underwent a body composition and a blood sampling. Information on eating habits was collected with a food frequency questionnaire and a 3-day food diary. **Results:** The study population consisted of 51 overweight/obese subjects (71% women; 29% men) with a mean age of 50.3 ± 13.5 years and a mean BMI of 29.4 ± 4.3. Based on the MEQ score, 13 participants had an evening chronotype (26%) and 38 (74%) a morning chronotype. No significant differences in weight and body composition according to chronotype were observed. However, differences emerged for eating habits, with a significantly ($p < 0.05$) higher number of evening subjects reported to consume sweets, soft drinks and fast food. Analysis of the food diaries showed that evening subjects had a significantly higher intake of daily calories (1867.6 ± 434. vs. 1612.2 ± 538.5 kcal/day), fat (78.2 ± 20.9 vs. 65.4 ± 23.8 g/day) and carbohydrates (226.1 ± 47.5 vs. 186.3 ± 77.6 g/day). The analysis of cardiometabolic risk circulating parameters showed that evening subjects had significantly lower folate values (4.69 ± 2.1 vs. 8.25 ± 6.36 ng/mL) than morning subjects, as well as significantly lower vitamin B12 values (349.6 ± 132.3 vs. 445.5 ± 144.5 pg/mL). **Discussion:** Evening subjects had worse eating habits and a higher intake of total daily calories, fat and carbohydrates, and also reported significantly lower values of folic acid and vitamin B12.

Keywords: obesity; chrono-nutrition; chronotype; dietary habits; cardiovascular risk

Author Contributions: Conceptualization, S.L., M.D. and F.S.; methodology M.D.; formal analysis, S.L.; investigation, S.L., M.D., B.C., G.P., M.T.A. and A.N.; data curation, S.L., M.D. and A.N.; writing—original draft preparation, S.L.; writing—review and editing, M.D., B.C., G.P., M.T.A. and A.N.; supervision, F.S. All authors have read and agreed to the published version of the manuscript. **Funding:** The research received no external funding.

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The Effect of a Maternal Cafeteria Diet on Adipose Tissue Browning in Rats and the Body Composition of Mothers and Their Offspring [†]

Anna Radziejewska ^{1,*}, Julia Matuszewska ², Joanna Sliwowska ¹ and Agata Chmurzynska ¹ 



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Obesity is a growing public health problem worldwide, including among pregnant women. The Western dietary pattern, with its high energy density and low nutritional value, supports excessive fat accumulation in the body and the obesity epidemic. Three types of adipose tissue are known: white (WAT), beige (BeAT), and brown (BAT). BAT and BeAT have the potential to oxidize fatty acids and glucose and dissipate energy in the form of heat. The aim of this study was to investigate the effects of a maternal cafeteria diet administered in an animal model prior to pregnancy, during pregnancy, and during lactation on the body composition and browning of adipose tissue of females and their offspring. Eight-week-old female Wistar rats were fed prior to conception, during pregnancy, and during lactation with a cafeteria diet (CAF) or a control diet (C). After weaning, the offspring were fed a standard AIN93G semisynthetic diet. Body mass and composition were measured (Minispec LF90II, Bruker). The transcript levels of *Ucp1* and *Cidea* in the rats' BeAT were determined using real-time PCR (LightCycler 480 II, Roche). The CAF offspring had lower body weights at PND 4 than the C group offspring (9.6 ± 0.3 vs. 10.4 ± 0.2 g, $p < 0.005$). CAF male and female offspring had lower body weight values than the control group from postnatal day (PND) 21 to 60 ($p < 0.05$). The amount of adipose tissue in females from the CAF group was lower than in group C females at PND 35 ($p < 0.05$). The CAF group had higher *Ucp1* transcript levels in male offspring at PND 40 and 45 ($p < 0.05$) than the C group, but the *Cidea* transcript levels did not differ between the groups. It was concluded that a maternal cafeteria diet affected the body weight of the offspring of both sexes. However, adiposity-related outcomes were affected in a sex-specific manner. The level of adipose tissue was lower only in female offspring. On the other hand, transcripts of the *Ucp1* gene, which is a marker of browning, were altered only in male offspring.

Keywords: cafeteria diet; *Ucp1*; adipose tissue; obesity

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Author Contributions: Conceptualization, A.C., J.S., A.R. and J.M.; methodology, A.C., J. S., A.R. and J.M.; software, A.R.; validation, A.R., A.C., J.S. and J.M.; formal analysis, A.R.; investigation, A.R. and J.M.; resources, A.R.; data curation, A.R.; writing—original draft preparation, A.R.; writing—review and editing, A.C. and J.S.; visualization, A.R.; supervision, A.C. and J. S.; project administration, A.R., A.C., J.S. and J.M.; funding acquisition A.R., A.C., J. S. and J.M. All authors have read and agreed to the published version of the manuscript.

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Association of Inflammatory Biomarkers with the Gut Microbiota and Short-Chain Fatty Acids in Prediabetic Subjects [†]

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Abstract: Background and objectives: The gut microbiota performs many functions in the host organism, and metabolites derived from its activity, such as short-chain fatty acids (SCFA), are involved in immunometabolism. Alterations in gut microbial composition play an essential role in diseases such as heart failure, kidney disease, obesity, and diabetes mellitus. The current work aimed to analyze the associations of serum and fecal inflammatory biomarkers with the microbiota and SCFA in prediabetic subjects. Methods: 65 prediabetic patients, diagnosed according to the American Diabetes Association criteria, who participated in a randomized controlled intervention study with *Moringa oleifera* Lam. (2.4 g/day), were included. Inflammatory markers (Serum C reactive protein [CRP] and fecal calprotectin and sIgA), gut microbiota (qPCR), and short-chain fatty acids (SCFA; GC-FID) were studied before (V0) and after a 12-week intervention (V12). Relationships were explored using principal component analysis (PCA). Lineal regression models were performed to determine the predictive variables of inflammatory markers by including SCFA and gut microbiota groups as one block of independent variables. Fat mass percentage (BIA) and treatment group were used to adjust the models. Analyses were performed for V0 and V12 separately. Results: Only for calprotectin were significant models found at V0 ($p = 0.044$) and V12 ($p = 0.010$). *Lactobacillus* (standardized beta, $\beta = 0.292$; $p = 0.047$) and *Bacteroides* ($\beta = 0.430$; $p = 0.009$) groups were significant predictors at V0 and *Lactobacillus* ($\beta = 0.339$; $p = 0.015$) and the SCFA valeric acid ($\beta = -0.533$; $p = 0.014$) were predictors of calprotectin in V12. For CRP, a trend was found at V12 regression ($p = 0.079$), with significant contributions for the *Blautia coccooides*–*Eubacterium rectale* group ($\beta = 0.585$; $p = 0.016$) and the categorical binomial variable “Above normal fat mass percentage” (“yes”, “no”) ($\beta = 0.478$; $p < 0.001$). No significant influence of the treatment group was observed. Discussion: Calprotectin levels seem to be dependent on microbiota and SCFA levels. Calprotectin showed a positive and consistent relationship with *Lactobacillus* spp.; however, its relationships with the *Bacteroides* group and valeric acid were not consistent and deserve further exploration. CRP and sIgA do not seem to be explained to a significant level by the microbiota and SCFA concentrations in this prediabetic population.

Keywords: gut microbiota; inflammatory markers; short-chain fatty acids; prediabetes; body fat mass

Author Contributions: Conceptualization, E.N., S.G.-M. and A.M.; methodology, S.G.-M., L.E.D.-P. and E.N.; participant’s interviews and laboratory procedures, S.G.-M., E.N., I.V.-C., L.E.D.-P., N.I. and M.C.M.-R.; formal analysis, E.N. and L.E.D.-P.; writing—original draft preparation, L.E.D.-P. and E.N.; writing—review and editing, all authors; All authors have read and agreed to the published version of the manuscript.

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More Thorough Mastication of Bread May Stimulate Early-Phase Insulin Release: Preliminary Associative Results from a Double-Blind Randomized Controlled Trial [†]

Georgia Chatonidi * , Boushra Dalile and Kristin Verbeke



Citation: Chatonidi, G.; Dalile, B.; Verbeke, K. More Thorough Mastication of Bread May Stimulate Early-Phase Insulin Release: Preliminary Associative Results from a Double-Blind Randomized Controlled Trial. *Proceedings* **2023**, *91*, 305. <https://doi.org/10.3390/proceedings2023091305>

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Abstract: Background and objectives: Oral processing behavior is suggested to

modulate metabolic responses to foods. In this study, we examined the impact of variations in oral processing characteristics during bread consumption on appetite and postprandial metabolic responses. Methods: Thirty healthy, normal-weight participants consumed three types of bread, differing in the leavening agent, in a randomized cross-over trial, while being video recorded to determine specific oral processing behaviors. At each study visit, gastric emptying, subjective appetites, and glucose and c-peptide levels were measured at regular time points for 4 h. After 4 h, the ad libitum energy intake was measured. The average values of each outcome were calculated to derive a single characteristic value per participant across the three types of bread. Results: A Spearman's correlation analysis showed that the participant age was associated with a faster eating rate ($r = 0.562$, $p = 0.001$), a shorter oral exposure time ($r = -0.569$, $p = 0.001$), and less chews/bites ($r = -0.387$, $p = 0.034$). As expected, a slower eating rate was correlated with more chews per bite ($r = -0.603$, $p < 0.001$). Surprisingly, higher hunger ratings before bread consumption were associated with a smaller bite size ($r = -0.518$, $p = 0.003$). More chews/bites were associated with a higher AUC of C-peptide during the first 30 min after consumption ($r = 0.398$, $p = 0.036$). Oral processing behavior did not correlate with appetite, the energy intake in the subsequent meal, gastric emptying, or the glucose response ($p > 0.05$) to bread. However, slower gastric emptying was associated with a lower glucose

AUC_{30min} ($r = -0.453$, $p = 0.015$) and c-peptide AUC_{30min} ($r = -0.631$, $p < 0.001$). Discussion: Although, overall, the metabolic responses to bread consumption were not affected by oral processing, thorough mastication of bread stimulated the cephalic phase of digestion, resulting in early release of insulin. This is in line with the existing literature, according to which anticipatory sight, smell, and taste of food can initiate the cephalic phase of insulin secretion, which is further enhanced by chewing and swallowing the food. However, the importance of the cephalic phase insulin release in overall glucose regulation is still unclear. Further research is needed to investigate to what extent and according to which mechanisms natural variations in oral processing can affect postprandial metabolic responses to food.

Keywords: oral processing behavior; mastication; appetite; food intake; glycemic response; insulin

Author Contributions: Conceptualization, G.C. and K.V.; methodology, G.C. and K.V.; software, G.C.; validation, G.C., B.D. and K.V.; formal analysis, G.C., B.D. and K.V.; investigation, G.C. and K.V.; resources, K.V.; data curation, G.C., B.D. and K.V.; writing—original draft preparation, G.C.; writing—review and editing, G.C., B.D. and K.V.; visualization, G.C.; supervision, K.V.; project administration, G.C. and K.V.; funding acquisition, K.V. All authors have read and agreed to the published version of the manuscript.

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Association between Dietary Choline and the Incidence of Type 2 Diabetes: Results from a Large Swedish Cohort [†]

Therese Karlsson ^{1,2,*}, Áine Ryan ², Bathsheba Tobin ², Ingegerd Johansson ³  and Anna Winkvist ^{2,4}



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Abstract: Background and Objectives: Type 2 diabetes (T2D) has become a major global issue in the past several decades with a rapidly increasing incidence largely attributable to sedentary lifestyles and westernized diets. Previous research has shown conflicting evidence between dietary choline and the risk of T2D. The present study aimed to investigate associations between dietary choline and its individual forms with the development of T2D. Methods: In total, 41,802 females and 37,952 males attending the Västerbotten Intervention Programme (VIP) between 1990 and 2016 were included. The intake of total choline and its individual forms phosphatidylcholine, glycerophosphocholine, phosphocholine, sphingomyelin and free choline were estimated from a food frequency questionnaire. The associations between dietary choline and T2D were estimated using the Cox proportional hazards regressions to determine hazard ratios (HR) and 95% confidence intervals (CI) for T2D according to total choline, phosphatidylcholine, glycerophosphocholine, phosphocholine, sphingomyelin and free choline intake (quartiles). Models were adjusted for reported energy intake, age, body mass index, education and smoking status. All analyses were performed in females and males separately. Results: During a median follow-up of 16 years, 1195 (2.9%) and 1664 (4.4%) incident T2D cases were registered in females and males, respectively. A higher total choline intake was associated with an increased risk of T2D in both females (HR Q4 vs. Q1: 1.44; 95% CI: 1.11, 1.85; P-trend 0.03) and males (HR Q4 vs. Q1: 1.53; 95% CI: 1.24, 1.90; P-trend < 0.01). Choline intake from phosphatidylcholine and sphingomyelin were positively significantly associated with the risk of T2D in both females and males. No associations were found between choline intake from free choline, phosphocholine or glycerophosphocholine and incidence T2D. Discussion: This study demonstrates an association between the higher intake of total choline and an increased risk of T2DM in females and males in Sweden. The positive association seems to be driven mainly by the intake of choline from phosphatidylcholine and sphingomyelin. This highlights the role of dietary choline intake in relation to T2D and the importance of exploring the impact of the different forms of dietary choline.

Keywords: choline; betaine; type 2 diabetes; prospective cohort; Västerbotten Intervention Program

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Conceptualization, T.K. and A.W.; formal analysis, T.K., Á.R. and B.T.; resources, I.J.; writing—original draft preparation, Á.R. and T.K.;

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Association of Unhealthy Lifestyle Score on the Risk of Hypertension, Dyslipidemia, and Their Comorbidity in Korea: A Cross-Sectional Study †

Ji-Sook Kong  and Mi Kyung Kim * 



Citation: Kong, J.-S.; Kim, M.K. Association of Unhealthy Lifestyle Score on the Risk of Hypertension, Dyslipidemia, and Their Comorbidity in Korea: A Cross-Sectional Study.

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evidence suggesting that lifestyle factors play a significant role in the development of hypertension and dyslipidemia. Rather than occurring individually, these conditions often coexist. Therefore, the aim of this study was to investigate the individual and combined effects of lifestyle factors on the risk of hypertension only, dyslipidemia only, and their comorbidity. **Methods:** This study included 9608 adults aged 19 years and above from the cross-sectional Korean National Health Examination Study between 2019 and 2021. An unhealthy lifestyle score was derived from five factors: smoking, alcohol consumption, body mass index (BMI), diet, and physical activity. Each participant was assigned an unhealthy lifestyle score based on the cumulative number of unhealthy factors present. A logistic regression model and multinomial logistic regression were used to estimate odds ratios (ORs) with 95% confidence intervals (95% CIs) after adjusting for confounders. The analysis aimed to assess the association between an unhealthy lifestyle and the risk of hypertension, dyslipidemia, and their comorbidity. **Results:** The prevalence of hypertension only, dyslipidemia only, and their comorbidity was 12.9%, 19.6%, and 16.4%, respectively. In the multivariable model, higher odds of hypertension alone were significantly associated with alcohol consumption and BMI status. Dyslipidemia alone and the comorbidity of hypertension and dyslipidemia were associated with all individual lifestyle factors. When compared to individuals with the highest unhealthy lifestyle score (4–5 scores), those with the lowest score (0–1 scores) had increased ORs of 5.38 (95% CI: 3.15–9.19), 4.08 (95% CI: 2.84–5.85), and 16.0 (95% CI: 9.34–27.5) for hypertension only, dyslipidemia only, and their comorbidity, respectively. Furthermore, even after stratifying by family history, individuals with the lowest lifestyle score were still associated with hypertension, dyslipidemia, and their comorbidity compared to those with the highest lifestyle score, regardless of their family history. **Conclusion:** These findings demonstrate a positive association between unhealthy lifestyle factors and the risk of comorbidity of hypertension and dyslipidemia, as well as hypertension and dyslipidemia alone. Moreover, lifestyle factors may influence the risk of hypertension and dyslipidemia, even in individuals with a family history of these conditions.

Keywords: hypertension; dyslipidemia; comorbidity; smoking; alcohol; BMI

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Author Contributions: J.-S.K.: Conceptualization, Formal analysis, Funding acquisition, Methodology, Writing—original draft, Writing—review & editing. M.K.K.: Conceptualization, Methodology, Writing—review & editing. All authors have read and agreed to the published version of the manuscript.

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Abstract: Background and objectives: There is increasing

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Short-Term Effects of Crackers on Glycemic Index and Glycemic Responses: A Randomized Clinical Trial in Healthy Adults [†]

Emilia Papakonstantinou ^{1,*}, Vasilis Alsab ¹, Foteini Lympaki ¹, Sofia Chanioti ², Marianna Giannoglou ²
and George Katsaros ²

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Abstract: Introduction: This study aimed to determine the glycemic index (GI)/glycemic load (GL) of three crackers made with different flours. A control cracker (CC), with a 30% w/w substitution of wheat by whole wheat flour (WWC) and with a 30% w/w substitution of wheat by sunflower seed flour (SFC), differing significantly in protein and fiber content, is compared to the reference D-glucose drink. Methods: In a randomized, controlled, crossover design, 11 healthy participants (23.5 (1) years; seven women; BMI 23 (1) kg/m²) were randomly assigned to receive three cracker meals (CC, WWC, and SFC), all containing 50 g of available carbohydrates and 50 g of D-glucose as a reference drink. Results: SFC provided medium GI, low GL values (GI: 56 on glucose scale, GL: 6 per serving), whereas WWC and CC provided high GI, medium GL values (GI: 77 and 90 on glucose scale, respectively; GL: 11 and 12 per serving, respectively). Both SFC and WWC provided lower postprandial glucose concentrations, lower glucose excursions, and lower peak glucose values compared to glucose and CC. All crackers were pleasurable and increased satiety when compared to glucose, without any significant differences between them. Conclusion: SFC and WWC, regardless of soluble fiber and/or protein content, attenuated postprandial glycemic response and improved subjective satiety, which may offer advantages for body weight and glycemic control. This trial was registered at Clinicaltrials.gov: NCT05702372.

Keywords: crackers; sunflower seed flour; whole wheat flour; glycemic index; glycemic responses



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The Importance of Nutritional Status Assessments for Preoperative Bariatric Patients: Correlations between BIA, CRP and Vitamin Status [†]

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Abstract: Background and Objective: Preoperative assessments of nutritional status are crucial for optimizing outcomes in bariatric surgery patients. Parameters such as bioelectrical impedance analysis (BIA), C-reactive protein (CRP), vitamin D, folic acid and vitamin B12 have been individually studied in relation to nutritional status in bariatric patients. However, a comprehensive understanding of their interrelationships and the importance of a preoperative nutritional status assessment is still needed. The objective of this study is to determine the baseline nutritional status, explore the correlations between BIA, CRP and vitamin status in preoperative bariatric patients, and to assess the significance of nutritional status evaluation before surgery. Methods: Nutritional status, including anthropometric measurements (determined by Tanita, MC-780 MA) and biochemical parameters, were obtained from medical records of 50 adult obese patients who attended a clinic between 2022–2023 and who were advised to have sleeve gastrectomy. A Spearman correlation was used to determine correlation between observed parameters. Results: Most of the patients were women (88%) with an average age of 41 ± 10 years. Their BMI ranged from 39.4 to 63.0 kg/m² and their body fat from 33.9% to 58.5%. The phase angle ranged from 4.6 ° to 7.1 °, while total body water (TBW) for all patients was below 45% for women and 50% for men. A deficiency was observed among 43%, 55% and 20% of patients for folic acid, vitamin D and vitamin B12, respectively. Elevated CRP was present in 73% of patients. A correlation ($p < 0.05$) was found between CRP and BMI ($r = 0.322$), and body fat ($r = 0.488$) and TBW ($r = -0.420$), while 25OH-vitamin D correlated ($p < 0.001$) with the same parameters but the correction was reversed (BMI, $r = -0.424$; body fat $r = -0.662$; TBW $r = 0.525$). Both vitamin B12 and folic acid correlated only with extracellular water ($r = -0.424$ and $r = -0.447$). Discussion: Preoperative sleeve gastrectomy patients with inadequate nutritional status and increased CRP levels made up a significant portion of this population. These findings highlight the need for preoperatively treating dietary deficiencies and inflammation. The long-term effects of preoperative dietary therapy on patient outcomes and general health in the context of bariatric surgery should be the main subject of future study. **Keywords:** bariatric surgery; nutritional status



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Can We Use Extracellular Water to Total Body Water Ratio as a Predictor of the Nutritional Status of Patients with Colorectal Cancer at the Time of Diagnosis? †

Mirna Šporc'ić¹, Irena Martinis¹, Jelena Pugelnik¹, Toni Kolak², Josip Baković², Božica Jerak^{3,†} and

Martina Bituh^{3,*} 



Citation: Šporc'ić, M.; Martinis, I.;
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, 298. <https://doi.org/10.3390/proceedings2023091298> , 298

Abstract: Background and objectives: Early nutritional assessments have the potential to improve prognostic outcomes of patients with colorectal cancer (CRC). Among all parameters measured by bioelectrical impedance analysis (BIA), extracellular water to total body water ratio (ECW/TBW) is a known prognostic factor for various diseases. The objective was to investigate the relationship between the ECW/TBW ratio and the nutritional status of CRC patients at the time of diagnosis. Methods: In this retrospective study, information about the patients' demographic characteristics and nutritional status, including anthropometric measurements (determined by Tanita, MC-780 MA) and biochemical parameters at the time of diagnosis, were obtained from 104 patient records. We divided patients into two groups according to median ECW/TBW ratio (45.25%) and compared the differences between groups using a Chi-square or Mann-Whitney U test. A Spearman correlation was used to determine the correlation between the ECW/TBW ratio and all observed parameters. Results: Groups with a lower ECW/TBW ratio were younger (67 [62.25–72] vs. 74 [65–79] ($p < 0.05$)), had higher body weight (kg) (86 ± 12 vs. 78 ± 13 ($p < 0.001$)), body mass index (kg/m^2) (28.6 ± 3.6 vs. 26.9 ± 4.6 ($p < 0.05$)), phase angle ($^{\circ}\text{PhA}$) (5.7 ± 0.7 vs. 4.6 ± 0.7 ($p < 0.001$)), sarcopenia index ($^{\circ}\text{SMI}$) (8.8 ± 1.2 vs. 7.5 ± 0.7 ($p < 0.001$)), albumin (g/L) (43 ± 3 vs. 41 ± 3 ($p < 0.001$)) and hemoglobin (g/L) (137.50 ± 19.34 vs. 131.00 ± 19.72 ($p < 0.05$)) compared to groups with a higher ECW/TBW ratio. A lower ECW/TBW ratio was predominant in males (75.4%) and among overweight patients ($p < 0.05$). A positive correlation was found between ECW/TBW and age ($r = 0.402$, $p < 0.001$), while negative correlations were observed between ECW/TBW and body weight ($r = -0.408$, $p < 0.001$), SMI ($r = -0.581$, $p < 0.001$), serum albumin ($r = -0.390$, $p < 0.001$), serum hemoglobin ($r = -0.295$, $p < 0.001$) and PhA ($r = -0.703$, $p < 0.001$). Discussion: Analysis indicates that groups with a lower ECW/TBW ratio had overall better nutritional status. Several studies state that abnormal fluid distribution affects prognosis in people with cancer. In our study, patients with a higher ECW/TBW ratio had a much worse degree of cell damage. An ECW/TBW ratio may be useful as an indicator of nutritional status in CRC at the time of diagnosis.

Keywords: colorectal cancer; nutritional assessment; ECW/TBW ratio; phase angle; sarcopenia index

Author Contributions: Conceptualization, I.M. and M.B.; methodology, I.M., M.B. and M.Š.; formal analysis, M.Š., B.J. and M.B.; investigation, T.K. and J.B.; resources, J.P., T.K. and J.B.; data curation, M.Š. and I.M.; writing—original draft preparation, M.Š.; writing—review and editing, I.M. and M.B.; visualization, M.B.; supervision, M.B. All authors have read and agreed to the published version of the manuscript.

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The Intake of Sucrose but Not of the Intense Sweetener Sucralose Is Associated with Postprandial Endotoxemia in Healthy Young Adults [†]

Raphaela Staltner ^{*}, Anja Baumann and Ina Bergheim



Citation: Staltner, R.; Baumann, A.; Bergheim, I. The Intake of Sucrose but Not of the Intense Sweetener Sucralose Is Associated with Postprandial Endotoxemia in Healthy Young Adults. *Proceedings* **2023**, *91*, 287. <https://doi.org/10.3390/proceedings2023091287>

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2023.

Abstract: Background and objectives: Similar to saturated fat, a diet rich in sugar may contribute to the development of overweight and obesity and associated metabolic diseases, like type 2 diabetes and metabolic dysfunction associated steatotic liver disease (MASLD). Herein, effects on intestinal microbiota composition and barrier function subsequently leading to an increased translocation of bacterial endotoxin and activation of Toll-like receptor (TLR) 4-dependent signaling cascade are discussed to be critical. In recent years, the use of artificial sweeteners to sweeten food and beverages has markedly increased despite a still limited knowledge on health effects. Results of animal studies suggest that an extended intake of sweeteners like sucralose may alter intestinal microbiota composition and gut barrier function when consumed at high levels. In the present pilot study, we assessed the effects of an acute intake of sucrose and the artificial sweetener sucralose in physiological relevant doses in beverages on postprandial endotoxemia in healthy, normal-weight young adults. Methods: A total of 11 men and women aged 24–31 year were enrolled in this randomized placebo controlled single-blinded study in cross-over design which was approved by the ethics committee of the University of Vienna (Clinical trial: NCT04788680). After an initial blood collection and a 2 day nutritional standardization, according to the recommendations of the German, Austrian and Swiss (DACH) nutritional societies, and a second fasted blood collection, participants consumed either a beverage containing sucrose (110 g), sucralose (180 mg, iso-sweet) or an isocaloric combination of sucralose (180 mg) + maltodextrin (110 g) in a randomized order along with a standardized breakfast. Blood was collected 1, 2 and 3 h after consumption of the beverage. Bacterial endotoxin levels in plasma were measured using LAL assay. Results: After nutritional standardization, bacterial endotoxin levels were significantly lower than before. Furthermore, 2 h after the intake of the sucrose sweetened beverage, bacterial endotoxin levels were significantly higher in plasma compared to baseline levels. A similar increase in bacterial endotoxin levels in plasma was not detected after the intake of the beverage sweetened with sucralose. Discussion: Our data suggest that the intake of a sucrose but not sucralose sweetened beverage results in post-prandial endotoxemia.

Keywords: sucrose; sucralose; intestinal permeability

Author Contributions: Conceptualization, I.B.; Formal analysis, R.S.; Funding acquisition, I.B. and A.B.; Investigation, R.S. and A.B.; Visualization, R.S. and A.B.; Writing—original draft, R.S., I.B. and A.B.; Writing—review & editing, R.S., I.B. and A.B. All authors have read and agreed to the published version of the manuscript.

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Diet Quality Assessment and Lipid Profile of Younger Adult Men with Hypercholesterolemia [†]

Irena Keser ^{1,*}, Sanja Trivunovic ² and Martina Delac ¹



Citation: Keser, I.; Trivunovic, S.; Delac, M. Diet Quality Assessment and Lipid Profile of Younger Adult Men with Hypercholesterolemia. *Proceedings* **2023**, *91*, 258. <https://doi.org/10.3390/proceedings2023091258>

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Abstract: The prevalence of hypercholesterolemia caused by an unhealthy lifestyle is increasing worldwide and is associated with an increased risk of cardiovascular diseases. One of the causes of hypercholesterolemia is an unhealthy diet. The aim of this study was to assess the diet quality by determining the daily intake of energy and nutrients in men with an increased serum concentration of total cholesterol (≥ 5.0 mmol/L) and LDL-cholesterol (≥ 3.0 mmol/L) and to determine whether there is an association between lipid profile and dietary parameters. The participants were males aged 20 to 40 years ($n = 52$). The average daily energy, macronutrient, and micronutrient intake was evaluated using the 24-h recall for two non-consecutive days. The average daily intake of total fat ($39.2 \pm 8.3\%$ kcal) and saturated fatty acids ($13.4 \pm 4.1\%$ kcal) was higher than recommended, and the intake of carbohydrates ($41.7 \pm 9.6\%$ kcal) and fiber (15.6 ± 12.4 g) was insufficient. The average daily intake of sodium and phosphorus was too high, while the intake of potassium, magnesium, and calcium was deficient. The intake of all vitamins, except for vitamin B₃ and vitamin B₆, was also insufficient. The average concentration of HDL-cholesterol in the participants was adequate (1.4 ± 0.2 mmol/L), but the concentration of triglycerides was elevated (1.9 ± 1.3 mmol/L). A statistically significant positive correlation was found between age and triglyceride concentrations ($r = 0.35$; $p < 0.05$). In this study, the influence of energy intake and observed nutrients on the lipid profile was not determined.

Keywords: hypercholesterolemia; diet quality; 24-h recall; lipid profile

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Relevance of High Glycemic Index Breakfast for Heart Rate Variability among Young Students with Early and Late Chronotypes [†]

Bettina Krueger ^{1,*} , Bianca Stutz ¹, Rasmus Jakobsmeier ², Claus Reinsberger ² and Anette Buyken ¹



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and Objectives: Previous reports suggest that spikes in plasma glucose affect cardiac autonomic modulation, reflected by a decrease in heart rate variability (HRV). Hence, the hypothesis of this analysis is that cardiac autonomic changes following an early high-glycemic-index (GI) breakfast are more prominent in individuals with later chronotypes than in those with earlier chronotypes because of their unfavorable metabolic situation at this time of the day. Similarly, chronotype-specific morning plasma melatonin levels could be mechanistically relevant for HRV changes following early high-GI breakfasts, as melatonin seems to influence glucose tolerance. Methods: Subjects with earlier (N = 22) and later chronotypes (N = 23) were asked to consume an intervention meal with a GI = 72 in the morning (7 a.m.). Chronotype was assessed by the Munich Chronotype Questionnaire. Plasma melatonin level was determined at approx. 8 a.m. Glucose data were collected by continuous glucose measurement. Blood volume pulses derived by wrist-worn wireless multisensors were used to assess successive interbeat intervals (IBIs). Time domain HRV parameters RMSSD (root mean square of successive differences of normal IBI), mean IBI and SDNN (standard deviation of normal-to-normal IBI) were calculated. Data from 36 participants (n = 21 early and n = 15 late chronotypes) met the following criteria for analysis: beats corrected <10% and effective sample rate > 60 s. HRV differences before vs. after breakfast were calculated and association with chronotype was analyzed by multivariable linear regression. Results: RMSSD, mean IBI and SDNN were higher in both chronotypes before a high-GI breakfast. Changes in the analyzed HRV parameters after a high-GI breakfast did not differ between persons with an earlier or later chronotype (all $p > 0.2$). Pooling the data from both chronotypes, a smaller change in mean IBI following a high-GI breakfast was associated with higher morning plasma melatonin levels ($p = 0.0232$). Neither age, sex nor BMI account for this association. Conclusions: These data suggest that in our very small cohort of young healthy adults, morning plasma melatonin levels, but not chronotype, are associated with parasympathetic HRV activity after an early high-GI breakfast.

Keywords: chronotype; melatonin; heart rate variability; glucose homeostasis; high GI breakfast

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Author Contributions: Conceptualization, A.B.; methodology, B.K.; validation, A.B., B.K., R.J. and C.R.; formal analysis, B.K.; investigation, B.K. and B.S.; resources, B.K.; data curation, B.K.; writing—original draft preparation, B.K.; writing—review and editing, B.K., B.S. and R.J.; visualization, A.B.; supervision, A.B. and C.R.; project administration, B.K.; funding acquisition, A.B. All authors have read and agreed to the published version of the manuscript.

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In Vitro Evaluation of the Effects of Plant-Based Protein Digestates on the Biology and Metabolism of Human Preadipocytes and Adipocytes

†

Catherine Lefranc-Millot ^{1,*}, Caroline Perreau ², Marion Bourdens ³, Noémie Juin ³ and Mayoura Keophiphath ³



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metabolism, and some inflammatory and profibrotic factors are key in modulating early fat mass expansion and chronic low-grade inflammation and could be targeted to prevent child obesity. Plant-based proteins are being increasingly used, and we evaluated the potential impact on adipose cell biology and the inflammatory processes of some of them, after simulated in vitro gastrointestinal digestion, on (1) the human preadipocyte differentiation, (2) their fibro-inflammatory state, (3) the metabolism of human mature adipocytes, and (4) the being potential of two selected digestates on preadipocytes. Methods: (a) Preadipocytes and (b) mature adipocytes isolated from human subcutaneous adipose tissues were treated with eight plant-based protein digestates (PBPDs) and one animal-based protein digestate for (a) 7 to 11 days or (b) 24 h, respectively. We assessed (a) their effects on preadipocytes, in proadipogenic ± proinflammatory conditions, by evaluating cytotoxicity, cell number, lipid droplet accumulation, adiponectin secretion, and UCP1 expression on the one hand, and IL6, CCL2, and fibronectin secretions on the other hand, and (b) their effects on adipocyte metabolism by studying cytotoxicity, lipolysis activity, and adiponectin secretion. Results: Six PBPDs stimulated adiponectin's secretion by the preadipocytes without affecting their viability and differentiation capacities at the tested doses. Similarly, we observed no cytotoxicity effects on mature adipocytes and a dose-dependent increase in their adiponectin secretion for treatment with five PBPDs. One PBPD modulated the lipolytic activity of adipocytes by decreasing the release of glycerol. In proinflammatory conditions, seven PBPDs reduced the number of preadipocytes, which is abnormally increased with inflammation. Two of them were able to decrease the CCL2 chemokine secretion, and one of them reduced the production of fibronectin, a potential pro-fibrotic protein. Finally, two selected PBPDs were able to increase beige differentiation (UCP1 expression) of preadipocytes cultured in proadipogenic conditions. Discussion: This study revealed potential benefits of plant proteins for obesity prevention, and specifically highlighted the respective properties of pea and oat proteins prototypes: increasing adiponectin secretion and beige differentiation in preadipocytes; decreasing pro-inflammatory and fibrotic molecules secretion by proinflammatory preadipocytes and regulating basal lipolysis and increasing adiponectin secretion by mature adipocytes.

Keywords: plant-based; proteins; preadipocyte; adipocyte; inflammation; being; obesity

Abstract: Background and Objectives: Excessive deposits of white adipose tissue lead to obesity. Preadipocyte differentiation, adipocyte

Author Contributions: Conceptualization, C.L.-M. and M.K.; methodology, M.K. and M.B.; software, D.I.V.A. EXPERTISE.; validation, M.K. and M.B.; formal analysis, M.B. and N.J.; investigation, M.K. and D.I.V.A. Expertise.; resources, D.I.V.A. Expertise.; data curation, D.I.V.A. Expertise; writing—original

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Assessment of Adherence to the Mediterranean Diet and Physical Activity Levels in a Group of Italian Celiac Disease Patients [†]

Giorgia Vici * , Laura Malandrino, Debora Giustozzi, Dalia Camilletti , Silvia Zufolino and Valeria Polzonetti 



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: The only treatment for celiac disease is a gluten-free diet, but this restriction can lead to nutrient imbalances and a reliance on processed gluten-free products that contain high levels of unhealthy ingredients. A lack of knowledge about naturally gluten-free foods poses challenges for celiac patients. Proper nutrition, based on the principles of the Mediterranean diet, along with regular physical activity, are of fundamental importance to improve overall wellbeing. This study aims to assess adherence to the Mediterranean diet and physical activity levels in adult celiac patients. Methods: This was an observational study carried out on 40 adult celiac patients following a gluten-free diet for at least one year. The level of physical activity was assessed through the International Physical Activity Questionnaire (IPAQ) (short version). The adherence to the Mediterranean diet (MD) was evaluated through the “Medi-Lite” questionnaire. Results: The outcomes unveiled difficulties concerning dietary patterns and adherence to the MD. The mean score for adherence to the MD was 9.3 ± 2.8 , on a scale of 0 to 18, where 0 represents the lowest adherence and 18 the highest. When analysing individual food components, it was found that fruit and vegetable consumption was suboptimal for most, and half of the population lacked sufficient cereal servings per day. The inadequate consumption of legumes, fish, and dairy products was observed, while an excessive intake of meat and cured meats was noted. Furthermore, the analysis of the IPAQ indicated that roughly three-quarters of the population were inactive or minimally active. Discussion: The results show that celiac patients tend to prefer protein foods for safety but have difficulties assessing protein source frequency. Inadequate dairy consumption is common, possibly due to secondary lactose intolerance from reduced lactase production caused by damaged villi. However, with abundant lactose-free products available, increasing milk and dairy consumption is important to prevent deficiencies in calcium, phosphorus, and vitamin D. The findings highlight the challenges celiac individuals face in adhering to a gluten-free diet and making appropriate food choices, leading to inadequate eating habits and nutritional deficiencies. Thus, there is a need for targeted nutritional education interventions to provide precise guidance on safe eating while meeting nutritional requirements for overall well-being, emphasizing the importance of physical activity.

Keywords: celiac disease; gluten-free diet; Mediterranean diet; physical activity; well-being

Author Contributions: Conceptualization, G.V. and V.P.; methodology, G.V. and V.P.; software, D.G.; validation, G.V., L.M. and V.P.; formal analysis, G.V. and L.M.; investigation, G.V., L.M., D.C., S.Z.; resources, V.P.; data curation, G.V. and L.M.; writing—original draft preparation, G.V. and L.M.; writing—review and editing, V.P.; visualization, V.P.; supervision, V.P. All authors have read and agreed to the published version of the manuscript.

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Nutrigenomic Effects of a High-Fat Diet and a Dietary Change to a Low-Fat Diet in the Pancreas in a Mouse Model of Pancreatic Carcinogenesis [†]

Irena Krga ^{1,*} , Joanna Wirkus ¹, Aya Samir Ead ¹ and Gerardo Guillermo Mackenzie ¹ 



Citation: Krga, I.; Wirkus, J.; Ead, A.S.; Mackenzie, G.G. Nutrigenomic Effects of a High-Fat Diet and a Dietary Change to a Low-Fat Diet in the Pancreas in a Mouse Model of Pancreatic Carcinogenesis. *Proceedings* **2023**, *91*, 222. <https://doi.org/10.3390/proceedings2023091222>

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Abstract: Pancreatic cancer is one of the deadliest cancers, with a 5 year survival rate of around 10% globally. Although

obesity is a modifiable risk factor for this cancer, the role of a high-fat diet (HFD) intake in pancreatic carcinogenesis, the effects of the dietary modification from an HFD to a low-fat diet, and the underlying molecular mechanisms of action are poorly defined. To contribute to understanding these relationships, we assessed the pancreatic global gene expression modulations using an LSLKras^{G12D}/+p48^{Cre/+} (KC) mouse model. Five-week-old mice were fed an HFD (60% energy from fat) or a control diet (11% energy from fat) until 6 months old. In an additional group, the mice consumed an HFD until 3 months old, and then switched to a control diet for 3 months to evaluate the effects of a dietary change to a low-fat diet (DC). Pancreata were collected, RNA was extracted and sequenced, and bioinformatic analysis was performed to identify the biological functions affected by the diets. The HFD significantly modulated the expression of 2166 genes involved in regulating cellular metabolism

(metabolic pathways, oxidative phosphorylation, and pancreatic secretion), cancer-specific functions (pathways in cancer and transcriptional misregulation in cancer), immune function (Th17, Th1, and Th2 cell differentiations) and cell signaling (cytokine–cytokine receptor interaction and chemokine signaling). The DC altered the expression of 988 genes more compared to that of the HFD, presenting an expression profile similar to the control diet. The modulated genes were linked with metabolic processes (pancreatic secretion, fat digestion, and absorption), cell signaling (chemokine signaling, NFκB, and TNF signaling pathways), and cancer-specific functions (proteoglycans in cancer and pathways in cancer). Over 800 genes, mainly linked with metabolic functions, were identified following both DC and HFD intake and presented opposing expression profiles, suggesting that a DC could counteract some nutrigenomic modulations prompted by an HFD. Moreover, this effect was mirrored in the pancreas and final body weights, with the DC mitigating the HFD-induced increases in both the parameters. In summary, we showed the multi-target mode of action of an HFD in the pancreas of KC mice accompanied by increases in pancreatic and body weights that were all neutralized by a 3-month-long switch to a low-fat diet. Further explorations of the possible regulators driving the observed multi-genomic effects are warranted.

Keywords: pancreatic cancer; high-fat diet; nutrigenomics; dietary modifications; low-fat diet

Author Contributions: Conceptualization, J.W., A.S.E., G.G.M., I.K.; investigation and methodology, I.K., J.W., A.S.E., G.G.M.; validation, J.W., A.S.E. and G.G.M.; formal analysis, I.K., J.W.; writing— original draft preparation, I.K.; writing—review and editing, J.W., A.S.E., G.G.M., I.K.; supervision, G.G.M.; project administration and funding acquisition, J.W., G.G.M. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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Changes in Gut Microbiota and Serum Metabolites in Patients with Extreme Obesity [†]

Libuša Kubánčová ^{1,2}, Adela Penesová ^{1,2,*} , Ivan Hric ^{1,2} , Jana Babjaková ³ , Eva Baranovičová ⁴, Marián Grendár ⁴ and Viktor Bielik ² 



Citation: Kubánčová, L.; Penesová, A.; Hric, I.; Babjaková, J.; Baranovičová, E.; Grendár, M.; Bielik, V. Changes in Gut Microbiota and Serum

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Abstract: Background and Objectives: In recent years, the crucial role of gut microbiota in the development and regulation of obesity and related metabolic conditions has been increasingly explored. This prospective cross-sectional study aimed to examine the differences in gut microbiota composition and energy metabolites between non-diabetic individuals with extreme obesity (EO) and healthy lean controls (HLC). Methods: A total of 19 non-diabetic participants with EO (average age \pm SD:

35.4 \pm 7.0 years, average BMI \pm SD: 48.8 \pm 6.7 kg.m⁻²) and 23 HLC participants (average age \pm SD: 31.7 \pm 14.8 years, average BMI \pm SD: 22.2 \pm 1.7 kg.m⁻²) were investigated. Fecal microbiota was analyzed and classified using specific primers targeting the V1–V3 region of 16S rDNA. Serum metabolites were characterized by nuclear magnetic resonance spectroscopy. Multivariate statistical analysis and Random Forest models were employed to identify predictors with the highest variable importance. Results: A significantly reduced microbial α -diversity; lower relative abundance of beneficial bacterium Akkermansia and SCFA-producing bacteria Eubacterium hallii, Butyrivibrio, Marvinbryantia, and Coprococcus; and increased abundance of pathogenic bacteria Bilophila and Fusobacterium were found in individuals with EO. Interestingly, energy metabolites (citrate and acetate), IR HOMA, and insulin were pinpointed as the most important predictors with exceptional ability to differentiate between EO and HLC participants by the Random Forest machine learning analysis. Conclusion: The findings suggest that changes in gut microbiota and serum acetate and citrate levels in patients with extreme obesity may serve as potential biomarkers for early progression to Type 2 diabetes. Consequently, weight loss interventions and non-invasive manipulation of gut microbiota composition in these patients could offer a novel strategy for managing obesity and related disorders.

Keywords: Gut Microbiota; extreme obesity Type 2 diabetes; energy metabolites

Author Contributions: Conceptualization, A.P. and V.B.; methodology, I.H. and J.B.; software, M.G.; validation, E.B., A.P. and V.B.; formal analysis, L.K.; investigation, L.K.; resources, V.B.; data curation A.P., L.K. and V.B. All authors have read and agreed to the published version of the manuscript.

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The Impact of Replacing Sugar in Sweets by Isomalt on Blood Glucose Management: Evidence from Recent Randomized, Controlled Trials [†]

Lisa Schweitzer * and Stephan Theis 



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Abstract: Background and objectives: National authorities

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and WHO recommend limiting consumption of added sugars from different foods. Polyols like isomalt can be used as bulk sweetener and thus help the food industry to replace sugar. Isomalt is a naturally sourced sugar replacer and the only one in its kind made from pure beet sugar. It has low physiological energy value (approximately 8.4 kJ/g), is non-cariogenic, and has low glycaemic properties as well as a very limited effect on insulin response. The present investigation aims to provide evidence from a series of recent randomized human intervention trials in which the respective effects of isomalt as low-digestible carbohydrate replacing sugar in various sweets were tested. **Methods:** Blood glucose and insulin response of different sweets were tested according to standardized test procedure. The sweets (i.e., chocolate, candies, mints and jam) were provided in realistic portion sizes and either contained sugar or sugar was replaced 1:1 by isomalt. Products were comparable in appearance, taste, and sweetness. 10 healthy adults (mean age: 40.6 ± 7.0 years, BMI: 23.5 ± 3.2 kg/m²) were randomly assigned to consume the sweets in the morning after an overnight fast. Capillary blood samples were taken at baseline up to 180 min to determine blood glucose and insulin levels. **Results:** Replacing sugar by isomalt led to significantly lower blood glucose response for all products. This was characterized by a significantly reduced incremental glucose peak (iCmax) ranging from −46% to −83% (all $p < 0.05$) and a reduction of the two-hour incremental area under the curve (iAUC2h) by 5% to 71% ($p < 0.05$ for candies, mints and jam). The lower glycaemic profile was accompanied by lower insulin levels. Accordingly, iCmax and iAUC2h following isomalt variants were remarkably reduced by 70 to 92% (all $p < 0.05$) and 58 to 87% (all $p < 0.05$), respectively. **Discussion:** With a series of RCTs conducted according to international standards in blood glucose response testing, we demonstrate reduced postprandial glycaemic and insulin response to various sweets in which sugar was replaced by isomalt. Hence, using isomalt as a naturally sourced sugar replacer is a viable strategy to support a low glycaemic diet.

Keywords: isomalt; polyol; sugar replacer; glycaemia; insulin; blood glucose management; sweeteners

Author Contributions: Conceptualization, L.S. and S.T.; methodology, L.S. and S.T.; formal analysis, L.S.; investigation, L.S. and S.T.; writing—original draft preparation, L.S.; writing—review and editing, L.S. and S.T.; visualization, L.S. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: L.S. and S.T. are employees of BENEO/Südzucker Group.

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Nutrition and Movement to Improve Quality of Life with Knee Osteoarthritis—The NUMOQUA Study [†]

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Abstract: Background and Objectives: Osteoarthritis (OA) has long been considered a degenerative disease of cartilage tissue resulting from bodily wear and tear. However, there is accumulating evidence that inflammation plays a key role in the pathogenesis of OA. In knee OA—the most common form of OA—exercise therapy as an effective component of early treatment mainly addresses functional deficits but not the inflammatory processes. In the course of the NUMOQUA project, an anti-inflammatory therapeutic diet named “Austrian OA Cuisine” was developed. It is based on the framework of the New Nordic Diet combined with the food-based dietary guidelines of Austria, the guidelines for OA, the Austrian food culture, and the principles of a sustainable diet. The present study examines the implementation of the “Austrian OA Cuisine” combined with the evidence-based exercise therapy GLA:D[®] (Good Life with osteoArthritis in Denmark) in patients with knee OA and the effects on quality of life, nutritional and inflammatory status, and oxidative stress parameters. Methods: A total of 60 participants aged 50 to 75 with knee OA will be included and randomly assigned either to the intervention group or the control group. All participants will undergo the GLA:D[®] program in the first six weeks. Additionally, the intervention group will receive nutritional group training and individual nutritional counseling on “Austrian OA Cuisine” over nine months. The control group will receive general information about a healthy lifestyle. Measurements at baseline and at four follow-up dates include nutritional, inflammatory, and oxidative stress parameters.

Furthermore, anthropometric and behavioral parameters and clinical data will be assessed. Results:

The recruitment of patients started in the autumn of 2022 and is expected to be completed by January 2024, followed by data collection in January 2025. Discussion: The prevalence of OA is expected to increase in the future due to ongoing demographic changes and rising obesity rates. The expected results will provide important evidence on whether this interdisciplinary therapeutic approach could be a new, cost-effective, and sustainable strategy to address the disease process of OA without negative side effects.

Keywords: osteoarthritis; GLA:D[®]; Austrian osteoarthritis cuisine; nutritional therapy; quality of life

Author Contributions: Conceptualization, B.W., E.H., G.L., O.N., K.-H.W. and S.N.; writing—original draft preparation, S.C.; writing—review and editing, S.C., B.W., E.H., G.L., O.N. and K.-H.W. All authors have read and agreed to the published version of the manuscript.

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Diurnal Differences in Glycaemic Responses to Meals Containing Different Bread Types among Persons at Risk for Type 2 Diabetes—Preliminary Results from a CarbHealth Sub-Study[†]

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Abstract: Background and Objectives: Insulin sensitivity has been shown to decrease during the day among persons at risk of type 2 diabetes (T2DM). It remains to be established whether this also results in differences in glycaemic response to meals rich in carbohydrates, e.g., bread meals. Hence, we determined whether diurnal differences between morning and evening meals containing breads could be observed among persons at risk of T2DM consuming different breads as part of their habitual diet. Methods: Analysis based on data from a multicentre randomised controlled trial (CarbHealth) conducted among participants with prediabetes at four study sites (Germany, Norway, Sweden) who received either a β -glucan-enriched bread or a non-enriched wholegrain control bread to replace their habitually consumed bread for 16 weeks. In Paderborn, Germany, participants wore a continuous glucose monitoring device during weeks 1 and 16. The incremental area under the curve (iAUC) in the two hours following a bread meal in the morning or evening was determined and compared using a *t*-test. Morning bread meals were defined as meals consumed between 06.00 and 11.00 a.m., and evening bread meals referred to meals consumed between 05.00 and 10.00 p.m. Results: Out of 47 participants, 20 and 13 who consumed β -glucan-enriched bread or wholegrain bread as part of their meals both in the morning and evening were considered. In persons consuming the β -glucan bread, the iAUC of evening bread meals was higher than in morning bread meals in week 1 only (evening 2 h iAUC = 1561 [\pm 760] mg/dL vs. morning 2 h iAUC = 1181 [\pm 500] mg/dL, $p = 0.03$). In the control bread-group, the iAUC was higher in evening bread meals than in morning bread meals in week 16 (evening 2 h iAUC = 2445 [\pm 1894] mg/dL vs. morning 2 h iAUC = 1764 [\pm 1314] mg/dL, $p = 0.04$). Discussion: These preliminary data from a small sample of persons with prediabetes indicate that diurnal differences in carbohydrate consumption may extend to the context of habitual carbohydrate-rich meals. If replicated, persons at risk of T2DM should be discouraged from consuming large amounts of bread in the evening.

Keywords: glycaemic response; prediabetes; bread

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A Randomised Controlled Trial to Determine the Effect of Unique Grain Fibre-Fortified Bread on Gastrointestinal Symptoms, General Wellbeing and Mental Health of Healthy Adults [†]

Hwei Min Ng ^{1,2,*} , Jasjot Maggo ^{1,2} , Catherine Louisa Wall ^{1,2} , Simone Birgit Bayer ^{1,2} ,
Nicole Clemence Roy ^{2,3,4}  and Richard Blair Gearry ^{1,2}



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Abstract: Background: High dietary fibre (DF) intake may have beneficial effects on gastrointestinal and brain interactions. Bread is an ideal vehicle to incorporate grain fibre to increase DF content. To date, no studies have explored the association between a habitual intake of bread fortified with unique grain fibre and gastrointestinal symptoms, general wellbeing, and mental health. Objective: To determine whether a four-week intake of bread fortified with unique grain fibre (thrice the amount of DF than control bread) improves subjective gastrointestinal symptoms, general wellbeing, and mental health compared to baseline and white toast (control bread) in healthy adults with low DF intake. Methods: A four-week, two-armed, placebo-controlled, double-blinded, randomised crossover study separated by a two-week washout period was conducted. Fifty-six participants with low DF intake (<18 g/day for females, <22 g/day for males) consumed three (females)/four (males) slices of fortified bread daily for four weeks then control bread and vice versa. Before and after each intervention phase, the participants completed seven self-reported questionnaires: the Gastrointestinal Symptom Rating Scale, Patient-Reported Outcome Measurement Information System-Anxiety and Depression Short Forms 8a, World Health Organisation Well-Being Index, Warwick-Edinburgh Mental Wellbeing

Scales, Multidimensional Fatigue Inventory Short Form, and the Subjective Vitality Scale. Results: Fifty-five participants completed all of the questionnaires before and after each intervention. The preliminary and blinded results showed no significant changes (all $p > 0.05$) in gastrointestinal symptoms, general wellbeing, and mental health following intervention and between interventions. Discussion: With thrice the amount of DF, the unique grain fibre-fortified bread did not cause gastrointestinal symptoms nor did it worsen general wellbeing and mental health in healthy adults with low DF intake. Encouraging the consumption of unique grain fibre-fortified bread could still be an acceptable and effective method to improve DF intake in a healthy adult population with low DF intake. Trial Registration: ACTRN12622000884707.

Keywords: bread; unique grain; dietary fibre; mental health; general wellbeing; gastrointestinal symptoms; randomised controlled trial

Author Contributions: Conceptualization, R.B.G. and N.C.R.; methodology, R.B.G. and N.C.R.; validation, R.B.G., N.C.R., C.L.W. and S.B.B.; formal analysis, H.M.N., J.M.; investigation, H.M.N., J.M., C.L.W., S.B.B., R.B.G. and N.C.R.; data curation, H.M.N., J.M.; writing—original draft preparation,

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H.M.N.; writing—review and editing, H.M.N., J.M., C.L.W., S.B.B., R.B.G. and N.C.R.; supervision, C.L.W., S.B.B., R.B.G. and N.C.R.; project administration, S.B.B.; funding acquisition, N.C.R. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was carried out in accordance with the International Conference of Harmonization Guidelines, national and local requirements, and the Declaration of Helsinki. Ethical approval was sought from the University of Otago Human Ethics Committee for Health (H22/061) and approval was also sought from the University of Otago Christchurch Maori Research Advisor. Prior to commencement, the study was registered at ANZCTR, registration number ACTRN12622000884707.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: Dataset available on request from the authors.

Conflicts of Interest: The authors declare no conflict of interest.

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Consumption of Ultra-Processed Food Is Independently Associated with Premature Mortality in Cancer Survivors: A Prospective Analysis from the Moli-sani Study in Italy [†]

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Consumption of Ultra-Processed Food Is Independently Associated with Premature Mortality in Cancer Survivors: A Prospective Analysis from the Moli-sani Study in Italy.

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Abstract: Background and objectives: There is poor knowledge on the role of diet in relation to mortality among cancer survivors. Available studies have mainly focused on diet quality, regardless of food processing, a well-described risk factor in numerous cohorts worldwide. We therefore examined the association of food processing with all-cause mortality in a sample of cancer survivors from the Moli-sani Study (2005–2010, Italy) and analysed biological pathways potentially underpinning these associations. Methods: Longitudinal analysis was performed on 799 men and women (mean age 63 ± 12 y) with a history of cancer at enrolment, followed for 11.8 y (median). Food intake was assessed using a 188-item FFQ. The Nova classification was used to categorize foods according to increasing levels of processing: (1) minimally processed food (e.g., fruits, meat); (2) culinary ingredients (e.g., butter, sugar); (3) processed food (e.g., canned fish, bread); (4) ultra-processed food (UPF; e.g., carbonated drinks, processed meat). We then calculated the proportion (%) of each Nova group on the total weight of food (g/d) by creating a weight ratio. The modified Food Standards Agency Nutrient Profiling System (FSAm-NPS) dietary index was used to assess overall diet quality. Shared biological risk factors for chronic diseases were analysed as potential mediators through change-in-estimate method. Results: In multivariable-adjusted COX analysis controlled for known risk factors and diet quality, a 5% increment of UPF intake in the diet was associated with 14% increased risk of premature mortality (HR = 1.14; 95%CI 1.01–1.29; $p = 0.03$), independent of diet quality; HRs associated with higher intakes of either unprocessed/minimally processed food, or culinary ingredients or processed food were, respectively, 0.94 (0.88–1.01; $p = 0.10$), 0.90 (0.75–1.06; $p = 0.21$ for 1% increment), and 1.02 (0.95–1.09; $p = 0.56$). Serum C-reactive protein levels and resting heart rate accounted together for 58% (p value < 0.01) of the association of UPF with mortality. Discussion: In a general adult population, increasing the dietary share of UPF was associated with higher risk of premature death among cancer survivors, independent of diet quality. This association was largely explained by altered levels of inflammation and resting heart rate. Further large cohorts are warranted to possibly confirm these findings and extend knowledge on the biological mechanisms underpinning these associations.

Keywords: ultra-processed food; cancer survivors; all-cause mortality; inflammation; diet quality

Author Contributions: Conceptualization, M.B. and A.D.C.; methodology, M.B. and A.D.C.; validation, S.C.; formal analysis, M.B.; data curation, S.C. and E.R.; writing—original draft preparation, M.B.; writing—review and editing, M.B.D., G.d.G. and L.I.; supervision, G.d.G. and L.I. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data underlying this article will be shared on reasonable request to the corresponding author.

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The Dietary Inflammatory Index (DII[®]) and Its Correlations with Metabolic Parameters in a Group of Patients with Type 2 Diabetes Mellitus[†]

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Abstract: Inflammation plays a key role in insulin resistance, metabolic syndrome, type 2 diabetes mellitus (T2DM) and cardiovascular risk. Subclinical inflammation has many causes, but diet seems to be a major component in the prognosis of related diseases. In nutritional research methodologies, there has recently been tremendous progress in identifying scores that can assess the inflammatory traits of diet. One of these scores is the Dietary Inflammatory Index (DII[®]). The aim of this study was to evaluate dietary intake and calculate the DII[®] in a group of patients with type 2 diabetes and correlate it with other metabolic parameters. **Methods.** We evaluated a group of patients with T2DM who presented for their routine checkup in our clinic. We assessed each patient’s anthropometric and metabolic parameters and evaluated dietary intake using EPIC FFQ, which was later interpreted using FETA. We calculated the DII[®] using the validated formula. **Results.** Our study was conducted on 263 patients with type 2 diabetes mellitus, among which 108 were men (41.1%). The average age in the studied population was 62.46 +/- 9.45 years, without significant differences between men and women. Only 16 patients (6.1%) were of normal weight, 86 were overweight (32.7%) and 161 presented as obese (61.2%). Men in our study group showed a significantly higher DII score than women, and they also had significantly worse metabolic parameters. The DII correlated with weight and body fat percentage. **Conclusions.** The DII showed a relatively high proinflammatory diet in patients with T2DM studied and found that men were more exposed to diet inflammation than women. This might suggest that nutritional interventions in patients with T2DM should be targeted particularly to this group of patients.

Keywords: Dietary Inflammatory Index; DII; type 2 diabetes mellitus

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Effects of Omega-3 Fatty Acid Supplementation on Revascularization and Major Cardiovascular Events: A Systematic Review and Meta-Analysis [†]

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Abstract: Background and Objectives: The clinical benefits of omega-3 fatty acid (FA) supplementation in preventing and treating cardiovascular disease remain controversial. The aim of this study was to investigate the effects of omega-3 FA administration on revascularization and adverse cardiovascular events including myocardial infarction, stroke, unstable angina, heart failure, and cardiovascular events/mortality using a meta-analytical approach. Methods: A comprehensive search of MEDLINE, Embase, Scopus, Web of Science, and Cochrane Library was performed throughout January 2023. Randomized controlled trials (RCTs) including at least 500 participants that compared the effects of omega-3 FA formulations (eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), or the combination) versus placebo or standard of care controls were considered eligible. Results: Our analysis included 17 RCTs that enrolled a total of 131,686 participants randomized to combined EPA + DHA ($n = 52,498$), EPA alone ($n = 13,415$), and control ($n = 65,771$). Overall, omega-3 FA supplementation was associated with reduced risk of revascularization [RR 0.91, 95% CI 0.84–0.99; $p_{\text{het}} = 0.0002$; $I^2 = 69\%$; $p = 0.02$] and myocardial infarction [0.89, 95% CI 0.80–0.98; $p_{\text{het}} = 0.04$; $I^2 = 45\%$; $p = 0.02$] compared to controls, but had no significant effects on stroke, unstable angina, heart failure, or cardiovascular events/mortality. Comparing combined EPA + DHA with EPA, EPA alone was associated with a greater reduced risk of revascularization [0.76, 95% CI 0.63–0.94] and myocardial infarction [0.72, 95% CI 0.62–0.83], and a significantly reduced risk of stroke [0.72, 95% CI 0.55–0.95] and unstable angina [0.73, 95% CI 0.62–0.85]. No significant differences were observed according to EPA + DHA dose, EPA dose, and statin use. Conclusions: Omega-3 FA supplementation was associated with a reduced risk of revascularization and myocardial infarction compared with controls. The use of EPA alone appeared to be associated with even greater benefits, but further high-quality studies are needed to clarify the role of omega-3 FA supplementation in the primary and secondary prevention of cardiovascular disease.

Keywords: omega-3; revascularization; cardiovascular disease; meta-analysis



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Spirulina's Effect on Paraoxonase Activity [†]

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Abstract: Hyperlipidaemia is a common worldwide problem associated with an increased risk of coronary and extra-coronary atherosclerosis and cardiovascular disease. Besides changes in lifestyle habits that include controlling the diet with moderate alcohol consumption and maintaining normal weight, medication is usually prescribed in addition. The antioxidative potential of functional food in the treatment of hyperlipidaemia continuously attracts growing attention. Paraoxonase enzyme (PON1) prevents the oxidation of low- and high-density lipoprotein (LDL and HDL) and, hence, has an important role in acting against lipid peroxides. The aim of this study was to evaluate *Spirulina platensis*'s influence on blood and hepatic PON1 activity in an animal model. Male Wistar rats (approved by the Institutional Bioethics committee No. III-2011-01) were randomly divided into five groups based on the applied diet (I—normal diet; II—normal diet with spirulina; III—lipogenic diet; IV—lipogenic diet with concomitant spirulina supplementation; and V—lipogenic diet with spirulina treatment). The differences in PON1 activity were related to diet type. A lipogenic diet rich in saturated fats impaired the PON1 activity. Both blood and hepatic PON1 activity were significantly increased after the administration of a normal diet with spirulina supplementation. As expected, significantly reduced blood PON1 activity was measured in the lipogenic diet group. Blood PON1 activity was decreased in groups III, IV, and V, but PON1 in both the blood and liver had a tendency to increase in groups IV and V. Based on the obtained results, PON1 activity is affected by hyperlipidaemia, and spirulina supplementation may promote enzyme activity.

Keywords: functional food; hyperlipidaemia; antioxidative potential



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Long-Term Sunflower Oil Diet Effects on Mouse Brain Lipid Metabolism [†]

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Abstract: Background and Objectives: Fatty acids play an important role in many physiological processes in different organs. Their effect is well documented in neurodegenerative diseases and inflammatory diseases. Also, the brain as an organ is known to be enriched by docosahexaenoic acid (DHA) and arachidonic acid (AA). However, there are not many studies showing the effect of long-term oil diets on brain lipid metabolism. The aim of this study was to investigate the effects of dietary sunflower oil (enriched with oleic acid, GA-ME-HA, Sarajevo, Bosnia and Hercegovina) on fatty acid profiles in the brain after 100 days of treatment. Methods: Six-week-old adult female C57BL/6 mice were used in these experiments. A total of 20 laboratory female C57BL/6 mice were randomly divided into two groups, the control (n = 10) and sunflower diet treatment groups (n = 10), enriched with 25% saturated/unsaturated fats in isocaloric diet conditions. Mice were obtained from the vivarium (Galenika a.d. Belgrade, Serbia) and housed at four or five animals per cage under identical and controlled conditions (temperature 22 ± 1 °C, humidity 65 ± 1%, 12 h circadian rhythm). Fatty acid ester analysis was performed by gas–liquid chromatography (Shimadzu, Kyoto, Japan) and presented as percentages of overall 100% fatty acids identified. Results: Our results showed that a sunflower oil diet increases DHA ($p < 0.05$) as well as arachidonic acid (AA) ($p < 0.05$). There was also a trend of increasing linoleic acid (LA), but it was not significant. Our future studies would perform more investigations.

Keywords: the brain; phospholipids; fatty acids; sunflower oil; C57BL/6 mice

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Plant Dominant Low-Protein Diet, Nutritional Status (Phase Angle) and Progression of Renal Failure: Case-Report Study [†]

Danijela Ristic-Medic ^{*}, Snjezana Petrovic, Biljana Pokimica, Marija Paunovic  and Vesna Vucic 



Citation: Ristic-Medic, D.; Petrovic, S.; Pokimica, B.; Paunovic, M.; Vucic, V.

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Abstract: Background and Objectives: High dietary protein intake can cause intraglomerular hypertension, which may result in kidney hyperfiltration, glomerular injury, and proteinuria. The quality of dietary protein from plant sources, animal protein is associated with an increased risk of end-stage chronic kidney disease (CKD). A plant dominant low-protein diet composed of $\geq 50\%$ plant-based sources may lead to favorable changes in the gut microbiome, which can modulate uremic toxin generation and slow CKD progression, along with a reduction in cardiovascular risk. Phase angle (PhA) as a nutritional evaluation parameter is a reliable marker for estimating muscle health and quality of life scale in CKD patients. We evaluated the effect of a calorie restrictive plant dominant low-protein diet (PLADO) on the progression of renal failure and nutrition status in the patient case report. Methods: A 68-year-old female, obese (BMI 31.9 kg/m²) with CKD grades 3 presented to her primary care physicians in October 2022, changed her diet from an unhealthy Western diet to a personalized PLADO (protein 0.6–0.8 g/kg/day), caloric-restricted diet rich in fiber, according to basal metabolic rate (energy intake 1400 kcal/day) prescribed by a dietitian doctor. Liver and thyroid function and ferritin and potassium levels were within normal limits. Habitual dietary intake was estimated with a food frequency questionnaire and their body composition, and PhA was measured using a bioimpedance analysis (InBody 770; Seoul, Republic of Korea). The optimal PhA cut-off value was identified as ≤ 4.4 for non-dialysis patients. Results: After 3 months, serum urea, creatinine, uric acid, and glucose levels were significantly reduced, and hematological parameters and potassium levels were not significantly different. BMI, visceral fat, and total body fat % decreased, while PhA and skeletal muscle mass were stable. Conclusions: We confirmed that the PLADO diet with $\geq 50\%$ plant protein can be safely recommended to patients with stage 3 CKD, as it slows down the progression of renal failure, and does not lead to a reduction in PhA. Therefore, there is a need for nephrology to include nutritional management of kidney disease in addition to the pharmacological axis.

Keywords: chronic kidney disease; low protein diet; phase angle; PLADO diet

Author Contributions: Case study design, D.R.-M. and B.P.; conducting study visits, D.R.-M. and S.P.; statistical analysis, M.P.; data interpretation, D.R.-M. and S.P.; writing- original draft preparation, D.R.-M.; writing- review and editing, V.V.; All authors contributed to the manuscript and approved the submitted version. All authors have read and agreed to the published version of the manuscript.

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The Effect of Cr(III) Supplementation in Combination with Diversified Zn Content in the Diet on the Cr Status in Wistar Rats [†]

Halina Staniek ^{*}, Ewelina Król and Zbigniew Krejpcio



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Diversified Zn Content in the Diet on the Cr Status in Wistar Rats.

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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Both Zn and Cr(III) independently show similar, beneficial effects on metabolic parameters, including carbohydrate and lipid metabolism particularly in patients with diabetes. However, the knowledge about the combined effect of Cr(III) supplementation in Zn

homeostasis disorders is insufficient. The aim of the study was to investigate the effect of chromium(III) supplementation in combination with diversified Zn content in the diet on the tissual Cr levels in healthy Wistar rats (male and female). The model studies were carried out on 72 (36♀ + 36♂) Wistar rats, which were divided into 12 groups (6 animals separately for each sex) and then fed ad libitum with 6 test diets for 6 weeks. The control groups (C) were fed a semi-synthetic AIN-93 diet with recommended levels of Zn (35 mg/kg) and Cr(III) (1 mg/kg) for rodents. The other groups were fed AIN-93 diets modified for Zn(II) content (D-Zn deficiency-5% RDA, OS-Zn oversupply-500% RDA). At the same time, the diets were supplemented with Cr(III) at doses of 1 and 50 mg/kg. The sources of Zn and Cr(III) were Zn(II) carbonate and Cr(III) propionate (Cr3), respectively. The tissular chromium levels were measured with the GF-AAS method. It was found that the Cr(III) supplementation as well as the varied Zn supply independently and in combination affected the hepatic and renal Cr contents in rats. Independently, Cr(III) supplementation increased the Cr levels in the liver and kidneys in both sexes. However, with the increase of the Zn supply in the diet decreased the renal Cr content in male (significantly) and female (insignificantly) rats. Both Zn deficiency and oversupply increased the Cr saturation in the liver in both sexes. A significant combined effect of the factors on the liver and kidney Cr content only in male rats was observed. The simultaneous Cr(III) supplementation significantly increased the liver Cr content with the recommended (by 68%) and excess (153%), but not deficient Zn supply in the diet. The research proved that the diversified Zn content in the diet, individually and in combination with Cr(III) supplementation affected the Cr status in healthy rats.

Keywords: chromium(III); zinc; deficiency; supplementation; rats

Author Contributions: Conceptualization, H.S.; methodology, H.S., E.K. and Z.K.; validation, H.S.; formal analysis, H.S.; investigation, H.S. and E.K.; data curation, H.S.; writing—original draft preparation, H.S.; writing—review and editing, H.S.; visualization, H.S.; supervision, H.S. and Z.K.; project administration, H.S.; funding acquisition, H.S. All authors have read and agreed to the published version of the manuscript.

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Investigation of the Postprandial Glycaemic Response to White Bread and Wholemeal Bread Consumption among Healthy Young Adults [†]

Honglin Dong ^{1,*} , Diana Galindo Pineda ², Ni Li ² and Yizhi Xu ²



Keywords: postprandial glycaemic response; fasting glucose; dietary fibre; bread

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Background and Objectives: Wholemeal bread is regarded as healthier than white bread due to its higher fibre contents and other nutrients, including phytochemicals and essential minerals, and is recommended to be included in the healthy diet over white bread [1]. This study aimed to investigate the difference in the postprandial glycaemic response to commonly consumed white bread and wholemeal bread in the UK in normal weight and healthy young adults. **Methods:** Designed as an acute randomized cross-over trial, 20 participants (10 white Caucasians and 10 Chinese, 20–31 y, BMI 18.5–24.6 kg/m²) were given two slices of wholemeal (fibre 6.7 g) and white bread (fibre 2.7 g) alongside 150 mL of pure orange juice and 10 g of butter on separate visits randomly (minimum of a 48-h interval) after fasting for 12 h. The blood glucose concentration was measured at time 0 (fasting), 30 min, 60 min, 90 min and 120 min postprandially through multiple finger pricks using a Biosen blood glucose analyser. The difference in the area under the curve (AUC) and the peak value (PV) between different bread intakes were analysed through a paired *t*-test and between groups (genders, ethnicities) using two-way repeated measures ANOVA. **Results:** Characteristics of the participants were as follows: age: 23.15 ± 3.3 y; body mass index (BMI): 21.0 ± 2.2 kg/m²; body fat composition: 19.9 ± 6.3%. The AUCs were significantly reduced after wholemeal bread meal consumption compared with white bread meal consumption (631.9 ± 66.8 mmol·min/L vs. 655.8 ± 56.6 mmol·min/L, *p* = 0.027). The AUCs were significantly less in females compared with males after both instances of bread meal consumption (white bread: female 630.2 ± 54.7 mmol·min/L, male 676.7 ± 51.2 mmol·min/L; wholemeal bread: female 593.7 ± 49.7 mmol·min/L, male 663.0 ± 64.2 mmol·min/L, *p* = 0.024). There was no significant difference in the PVs between the genders. No difference in either the AUCs or PVs was observed between ethnic groups, though Chinese participants had significant lower fasting blood glucose levels than their counterparts. **Discussion:** The wholemeal bread did deliver a beneficial effect for the postprandial glycaemic response compared with white bread consumption. Female participants show significant lower postprandial glycaemic response than males regardless of white or whole meal bread consumption.

Author Contributions: Conceptualization, H.D. and Y.X.; methodology, H.D. and Y.X.; investigation, D.G.P. and N.L.; data analysis, H.D. and Y.X.; writing—original draft preparation, H.D.; writing—review and editing, Y.X.;

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Reference

1. Lockyer, S.; Spiro, A. The role of bread in the UK diet: An update. *Nutr Bull.* **2020**, *45*, 133–164. [[CrossRef](#)]

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Gut Microbiome Composition Associated with Body Weight in People with Type 1 Diabetes and Related to Dietary Factors [†]

Giuseppe Scidà ^{1,*} , Alessandra Corrado ¹ , Jumana Abuqwider ¹, Giuseppina Costabile ¹ ,
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Abstract: Background and Objectives: The gut microbiome composition has emerged as a potential contributor to metabolic health and it is influenced by several factors, such as dietary factors. Individuals with type 1 diabetes (T1D) experience metabolic dysregulation, including alterations in body weight; as a result, the prevalence of overweight/obesity is increasing in this population. Limited research has addressed the role of the gut microbiota on body weight in people with T1D. Our aim is to evaluate the association between BMI and gut microbiome composition in T1D patients, also exploring the relationship between dietary factors and the microbiota. Methods: A cross-sectional study was conducted involving T1D patients ($n = 101$) of both sexes, aged 18–79 years. Anthropometric parameters were measured, and the European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire was administered to evaluate dietary habits. Patients collected stool samples that were analyzed by shotgun metagenomics sequencing for the evaluation of the gut microbiota composition. Associations between BMI, gut microbiome composition, and dietary factors were evaluated by Pearson's bivariate correlation. Results: BMI was correlated inversely with the Bacilli ($r = -0.296$, $p = 0.004$) and Gammaproteobacteria ($r = -0.280$, $p = 0.009$) classes and directly with the abundance of the Clostridia class ($r = 0.220$, $p = 0.031$) and one of its species *Faecalibacterium prausnitzii* ($r = 0.264$, $p = 0.010$). The presence of these taxa was associated with dietary factors: Bacilli was inversely correlated with the consumption of animal protein ($r = -0.242$, $p = 0.019$), monounsaturated fatty acids ($r = -0.214$, $p = 0.038$), linolenic acid ($r = -0.236$, $p = 0.022$), oleic acid ($r = -0.205$, $p = 0.048$), and cholesterol ($r = -0.204$, $p = 0.048$); *Faecalibacterium prausnitzii* was directly associated with the intake of cholesterol ($r = 0.218$, $p = 0.034$) and simple sugars ($r = 0.226$, $p = 0.028$). Clostridia was correlated directly ($r = 0.225$, $p = 0.027$) and Gammaproteobacteria inversely ($r = -0.216$, $p = 0.045$) with alcohol intake. Discussion: BMI was associated with the Clostridia, Bacilli, and Gammaproteobacteria classes. These bacteria were related to various dietary factors. Therefore, changes in the gut microbiota could be a possible link between dietary habits and overweight/obesity in people with T1D.

Keywords: gut microbiome; body weight; dietary factors; type 1 diabetes

Author Contributions: Conceptualization, L.B. and G.S.; validation, L.B. and G.C. and D.E.; formal analysis, G.S. and A.C. and J.A.; investigation, G.S. and A.C.; data curation, G.S. and A.C. and J.A.; writing—original draft preparation, G.S. and L.B.; writing—review and editing L.B. and F.D.F.; supervision, L.B. and D.E.; funding acquisition, L.B. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Federico II University Ethics Committee (protocol code: 330/20, 18 December 2020).

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Gut Microbiome Composition Is Associated with Blood Glucose Control and Dietary Intake in People with Type 1 Diabetes [†]

Jumana Abuqwider ^{1,*}, Giuseppe Scidà ¹ , Alessandra Corrado ¹ , Giuseppina Costabile ¹ , Francesca De Filippis ² , Danilo Ercolini ² and Lutgarda Bozzetto ¹ 



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Abstract: Background: Blood glucose control remains a challenge for type 1 diabetes (T1D) patients. Previous studies have shown an association between gut microbiota composition and T1D pathogenesis. However, little is known about the composition of the gut microbiota and its association with host blood glucose control and diet in people with T1D. Objective: We explored the relationship of gut microbiome composition with blood glucose control and dietary intake in people with T1D. Research design and methods: In a cross-sectional study, a metagenomic shotgun sequencing analysis of the gut microbiome obtained from fecal samples was performed in 101 individuals with T1D. Dietary intakes were assessed by using the European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire. Blood glucose control was assessed by continuous glucose monitoring and expressed as time-in-range (TIR), time spent in the blood glucose interval 70–180 mg/dL. Spearman’s correlation analysis was used to determine the correlation between gut microbiota composition, blood glucose control, and dietary intake. Results: TIR correlated positively with the abundance of Bacilli ($r = 0.258$, $p = 0.027$) and negatively with the Lachnospiraceae family ($r = -0.238$, $p = 0.024$), *Mediterraneibacter* ($r = -0.249$, $p = 0.034$), *Coprococcus* genus ($r = -0.286$, $p = 0.016$), *Coprococcus comes* ($r = -0.257$, $p = 0.028$), and *Ruminococcus torques* ($r = -0.261$, $p = 0.026$). The presence of these taxa was associated with the intake of various foods: Bacilli correlated positively with dairy products ($r = 0.307$, $p = 0.002$) and negatively with olive oil ($r = -0.207$, $p = 0.041$) and meat products ($r = -0.255$, $p = 0.012$). Lachnospiraceae correlated negatively with cereals ($r = -0.263$, $p = 0.009$). *Mediterraneibacter* correlated positively with meat and meat products ($r = 0.230$, $p = 0.023$). *Ruminococcus torques* correlated negatively with fruit intake ($r = -0.227$, $p = 0.025$). Discussion: Our findings highlight that gut microbiota composition may be related to blood glucose control in T1D and dietary factors may have a role in this interplay. Further investigations are needed to address whether these findings are causally linked and whether to target these gut microbiota taxa.

Keywords: gut microbiome; glycemia; time-in-range; diet

Author Contributions: Conceptualization, J.A. and L.B.; validation, J.A., L.B., G.C. and D.E.; formal analysis, J.A., A.C. and G.S.; investigation, J.A. and A.C.; data curation, J.A., A.C. and G.S.; writing—original draft preparation, J.A. and L.B.; writing—review and editing L.B. and F.D.F.; supervision, L.B. and D.E.; funding acquisition, L.B. All authors have read and agreed to the published version of the manuscript.

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Nutrition as a Part of Lifestyle Medicine Interventions [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and Objectives: The epidemic of non-communicable diseases (NCDs) affects the lives of millions of people around the globe. It poses devastating health consequences for individuals, families and communities, threatening to overwhelm health systems. Non-communicable diseases, including heart disease, stroke, cancer, diabetes and chronic lung disease, are jointly responsible for around 75% of all deaths worldwide. The major NCD risk factors are modifiable behaviors such as tobacco use, unhealthy diet, physical inactivity and alcohol abuse. The European Commission has estimated that health promotion and disease prevention strategies can reduce the burden of NCDs by up to 70%. Taking this into consideration, the imperative approach to reducing the spread of NCDs is to control related risk factors. Methods: A literature review was performed by using major search engines such as Google Scholar, PubMed and ScienceDirect. The keywords used in the search were ‘nutrition’, ‘lifestyle interventions’, and ‘NCD’. The collected information was then critically assessed. Results and discussion: Lifestyle medicine (LM) is a branch of medicine focused on preventive healthcare and self-care dealing with the prevention, education, research and treatment of disorders caused by lifestyle factors. It aims to improve individuals’ health and quality of life through the six pillars of LM: nutrition, physical activity, sleep, stress management, avoidance of risky substances and positive social connection. Multiple studies have demonstrated that a lifestyle incorporating health-promoting practices profoundly impacts health and quality of life. The rising reputation of lifestyle medicine interventions can be attributed to their effectiveness in managing chronic conditions such as type 2 diabetes, metabolic syndrome, cardiovascular disease and obesity. Nutrition is one of the leading lifestyle modification factors with an impact on health status. An appropriate diet could reduce NCD risk and increase life expectancy due to different mechanisms, including effects on the immune system, gut microbiome modulation, anti-inflammatory properties, and others. Nutrition in particular plays a prominent role in LM interventions as it is essential to promoting health and preventing or even reversing disease. It is an integral part of LM interventions and is critical for the success of any LM program.

Keywords: lifestyle interventions; nutrition; non-communicable diseases; NCD prevention



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Association between the Postprandial Glucose and Insulin Response and Changes in Anthropometric Parameters after an 8-Week Formula Diet—Data from the Lifestyle Intervention Study [†]

Anna Reik ^{1,*} , Gunther Schaubberger ², Meike Wiechert ¹ , Hans Hauner ^{1,3}  and Christina Holzapfel ^{1,4} 



Citation: Reik, A.; Schaubberger, G.; Wiechert, M.; Hauner, H.; Holzapfel, C. Association between the Postprandial Glucose and Insulin Response and Changes in Anthropometric Parameters after an 8-Week Formula Diet—Data from the Lifestyle Intervention Study. *Proceedings* **2023**, *91*, 175. <https://doi.org/10.3390/proceedings2023091175>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and Objectives: There is a high inter-individual variability in the postprandial response to an oral glucose tolerance test (OGTT). However, there is limited evidence on whether the individual postprandial response is associated with the success of a weight management intervention. This work examines postprandial glucose and insulin response to an OGTT as predictors for changes in anthropometric parameters after a standardized weight loss intervention. Methods: Adults (18–65 years) with a body mass index (BMI) between 30.0 and 39.9 kg/m² were recruited for the Lifestyle Intervention (LION) study (NCT04023942). Blood samples were taken before the start of the 8-week formula diet and during an OGTT. Several parameters describing the postprandial glucose and insulin response (e.g., area under the curve, peak time, and concentration) were calculated. Anthropometric parameters (e.g., body weight, fat mass) were collected before and after the 8-week formula diet. Finally, regression analyses adjusted for age and sex were fitted. Results: A total of 272 participants (mean age 45 ± 11 years, BMI 34.5 ± 2.9 kg/m², 64% women) were included in the analysis. The formula diet resulted in an average weight loss of 11.8 ± 3.5 kg body weight and 8.2 ± 2.5 kg (4.1 ± 2.2%) fat mass. Postprandial parameters describing the glucose or insulin response from a total of 161 OGTTs showed no significant associations with changes in anthropometric parameters. Discussion: The examined postprandial glucose or insulin responses are not associated with weight loss success after an 8-week formula diet.

Keywords: postprandial response; metabolism; weight loss; lifestyle intervention; personalized nutrition

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Synergistic Effect of Oat Polar Lipids and Oat Beta-Glucans on Postprandial Blood Glucose: A Randomized Controlled Crossover Study in Healthy Subjects [†]

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Keywords: oat; oat polar lipids; oat beta-glucan; postprandial glycaemic response; satiety

Background/Aim: The identification and development of high-quality, healthy foods are needed to help prevent metabolic diseases such as obesity and type 2 diabetes. The intake of oat beta-glucans (OBGs) at a dose of 4 g per 30 g of available carbohydrates decreases the postprandial glycemic response and has the potential to increase perceived satiety. The intake of oat polar lipids (OPLs) has been shown to improve cardiometabolic markers in healthy subjects [1]. This study aimed to investigate the possible synergistic effects of OBGs and OPLs on postprandial glucose metabolism and subjective appetite variables. **Methods:** One control (plain white wheat bread (WWB)) and four test products were included. The test products consisted of WWB supplemented with (a) 2 g or (b) 4 g of OBGs per 30 g of available carbohydrates, (c) WWB + 4 g of OPLs, and (d) WWB + 2 g of OBGs (as above) + 4 g of OPLs. The OPLs were provided as a spread on the bread slices. Each breakfast contained a total amount of 50 g of available carbohydrates. Blood samples for glucose measurements were collected in a fasting state and at regular time points for 3 h after the consumption of each breakfast. Subjective appetite-related parameters were measured using a visual analogue scale. **Results:** Twenty healthy, young volunteers (24 ± 2 years of age) with a normal BMI (22.9 ± 1.9 kg/m²) completed this randomized controlled crossover study. Postprandial blood glucose responses (iAUC, 0–180 min) were significantly decreased after the intake of WWB + 4 g of OBGs (124 ± 10 mmol.min/L) and WWB + 2 g of OBGs + 4 g of OPLs (130 ± 9 mmol.min/L) compared to the WWB control (198 ± 21 mmol.min/L) ($p < 0.05$). No significant glucose-lowering effect was observed after an intake of the WWB + 2 g of OBGs (162 ± 16 mmol.min/L) or WWB + 4 g of OPLs (141 ± 15 mmol.min/L) compared to the WWB control. Subjective satiety tended to decrease after the intake of the breakfast containing 4 g of OBGs compared to the control breakfast. **Conclusion:** We conclude that a low dose of OBGs (2 g) ingested together with 4 g of OPLs has a blood-glucose-lowering effect, and this effect is of the same extent as 4 g of OBGs, i.e., no synergy effect was observed.

Author Contributions: Conceptualization, L.C., A.N. and J.T.; methodology, M.M.H. and W.D.; software, W.D.; validation, M.M.H. and W.D.; formal analysis, W.D.; investigation, M.M.H. and W.D.; writing—original draft preparation, L.C. and W.D.; writing—review and editing, L.C., M.M.H., J.T. and A.N.; visualization, L.C.; supervision, L.C, J.T. and A.N.; project administration, L.C. and A.N. All authors have read and agreed to the published version of the manuscript.



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Reference

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Selecting Type of Grain and Bigger Particle Size to Modulate Starch Digestibility and Glycemic Response [†]

Alexandra Meynier *[†], Isabel Moreira De Almeida and Sophie Vinoy



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Abstract: Context and Objectives: Cereals and pseudo-cereals show a variety in terms of shape and color but also nutrition composition and starch structure. Altering

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particle size and grain integrity may influence the availability of nutrients and their metabolic impact. We studied the impact of different grains with bigger particle sizes than flours on starch digestibility and glycemic and insulinemic indexes in humans. Methods: Moist biscuits, containing 40% of intact grains of quinoa, millet, teff, fonio, or buckwheat grits, and a control made with wheat flour, were produced. Starch digestibility of the final products was analysed according to the Englyst method after two preparation methods: mincing, which led to conditions close to mastication or milling, which led to sample pulverization. Glycemic and insulinemic indexes (GI; II) and response parameters following consumption of these products were evaluated in humans. Product portions provided 50 g of available carbohydrates. The study was performed on 19 healthy normal-weight subjects who tested all six moist biscuits according to a cross-over design. Results: Starch digestibility analyses in minced products showed low Slowly Digestible Starch (SDS) content in control, high SDS content in buckwheat biscuits, high SDS and resistant starch (RS) contents in quinoa and fonio, and high RS in teff and millet products. When analysing milled samples, SDS and RS decreased in buckwheat and quinoa biscuits. RS decreased and SDS increased in teff and millet, and the values remained similar to minced samples for fonio biscuits. GI values for the products were 60 ± 7 for quinoa, 55 ± 7 for millet, 52 ± 7 for control and buckwheat, 41 ± 9 for teff, and 39 ± 5 for fonio biscuits. Teff and fonio biscuits led to lower glycemic responses compared to the other products. Insulin responses were related to the glycemic responses. Conclusions: The type of grains and the use of intact grains strongly impact starch digestibility, allowing for the modulation of glycemic and insulinemic responses. Using different types of grains to wheat and different particle sizes would allow for the modulation of glucose metabolism and potentially lead to long-term beneficial health effects.

Keywords: grains; particle size; starch digestibility; glycemic response

Author Contributions: Conceptualization, A.M., I.M.D.A. and S.V.; methodology, A.M., I.M.D.A. and S.V.; formal analysis, A.M. and S.V.; investigation, A.M. and S.V.; data curation, A.M. and S.V.; writing—original draft preparation, A.M.; writing—review and editing, A.M. and S.V. All authors have read and agreed to the published version of the manuscript.

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Adherence to the WCRF/AICR Cancer Prevention Recommendations and All-Cause Mortality among Cancer Survivors from the Moli-sani Study Cohort [†]

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Abstract: Background and objectives: The guidelines provided by the World Cancer Research Fund/American Institute of Cancer Research (WCRF/AICR) aim to reduce the risk of developing cancers worldwide. The WCRF/AICR advises cancer survivors to follow the same recommendations for cancer primary prevention. These recommendations have been operationalized into a quantitative index based on a total of seven or eight healthy lifestyles; the points-based system allows for scoring a full point and, in some cases, partially meeting a recommendation. Evidence of the usefulness of the WCRF/AICR recommendations in populations different from those in the US is scarce. The aim of the present study was to assess whether compliance with the 2018 WCRF/AICR recommendations for cancer prevention is related to all-cause mortality among cancer survivors recruited in the Molisani Study cohort in Italy (2005–2010). Methods: A longitudinal analysis of 786 participants (59.7% women) with a history of cancer at study entry were analyzed. The 2018 WCRF/AICR score included seven components: body weight, physical activity, plant-based foods, fast foods, red and processed meat, sugar-sweetened beverages, and alcohol; the optional breastfeeding component was excluded. The final score ranged between 0 and 7 points, with higher values reflecting greater alignment with the WCRF/AICR recommendations. Multivariable Cox proportional hazard models adjusted to account for sociodemographic factors and major health conditions were fitted for estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for all-cause mortality. Results: The sample consisted of cancer survivors with an average age (SD) of 62.7 years old (11.7). Over a median follow-up of 11.8 years, a total of 220 deaths were registered. The median WCRF/AICR score was 4.6 ± SD 0.9. In multivariable-adjusted analyses, the risk of mortality was lower for participants who scored >5 points (HR = 0.54; 0.37–0.78; *p* value = 0.0010) compared to those who scored 0–4 points. Each one-point increment in the WCRF/AICR score was associated with a 22% decreased risk of all-cause mortality (HR = 0.78; 0.66–0.90; *p* value = 0.0012). Discussion: Higher compliance with the WCRF/AICR recommendations regarding diet, physical activity, and body weight was associated with lower all-cause mortality risk among cancer survivors. These findings suggest that cancer survivors should be encouraged to increase their adherence to the WCRF/AICR recommendations.

Keywords: WCRF/AICR recommendations; cancer prevention; mortality; cancer survivors

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Nutrition-Related Factors and the Progression of Metabolic Syndrome Characteristics over Time in Older Adults: Analysis of the TUDA Cohort †

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Abstract: Metabolic syndrome (MetS) is associated with an increased risk of cardiovascular disease and type 2 diabetes mellitus by an estimated two- and five-fold, respectively. Nutrition intervention could help to prevent the progression of MetS and associated pathologies with age, but the precise dietary components and related factors are not well understood. Therefore, the aim of this study was to evaluate the role of nutrition-related factors in MetS as well as the progression of MetS and its components over a 7-year follow-up period in older adults. This investigation involved the secondary analysis of data from the North–South of Ireland Trinity–Ulster–Department of Agriculture (TUDA) study of community-dwelling older adults (≥ 60 y), which were sampled at baseline (2008–2012; $n = 5186$) and follow-up (2015–2018; $n = 953$). Participants were deemed to have MetS if they met at least three of the following criteria: waist circumference (≥ 102 cm for males, ≥ 88 cm for females); HDL cholesterol (< 1.0 mmol/L for males, < 1.3 mmol/L for females); triglycerides (≥ 1.7 mmol/L); blood pressure (systolic ≥ 130 and/or diastolic ≥ 85 mmHg); and HbA1c (≥ 39 mmol/mol). The prevalence of MetS increased with advancing age (67% at baseline vs. 74% at follow-up). The factors at baseline that were predictive of a higher MetS risk at follow-up included waist circumference (OR 1.04, 95% CI 1.00–1.08; $p = 0.038$) and triglycerides (OR 1.77, 95% CI 1.21–2.59; $p = 0.003$). In a detailed dietary analysis conducted at the follow-up time point, higher protein intake (g/kg body weight) was associated with a lower risk of MetS (OR 0.06, 95% CI 0.02–0.20; $p < 0.001$), abdominal obesity (OR 0.10, 95% CI 0.02–0.51; $p = 0.006$), and hypertension (OR 0.022, 95% CI 0.00–0.80; $p = 0.037$), and a higher MUFA intake (g/day) was associated with a lower risk of MetS (OR 0.88, 95% CI 0.78–1.00; $p = 0.030$). No other dietary factors were significantly associated with MetS. In terms of protein quality, participants with MetS compared to those without consumed fewer high-quality protein foods ($p = 0.009$) and consumed more low-quality protein foods ($p < 0.001$). Dietary intervention along with other strategies focusing on potentially modifiable risk factors may delay the progression of MetS in older adults. Efforts to enhance the quantity and quality of protein intake may be warranted to reduce MetS in certain at-risk groups.

Keywords: metabolic syndrome; older adults; nutrition-related factors; protein quality



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Effects of Long-Term Sunflower Oil vs. Linseed Oil Diets on Fatty Acids Phospholipids and Desaturases in Hepatocytes [†]

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Abstract: Background and Objectives: The liver plays a central role in the biosynthesis and metabolism of fatty acids. The liver's phospholipids fatty acids composition depends on the dietary intake of lipids and the efficiency of enzymatic activity in the liver. Our study aimed to simultaneously investigate the liver's phospholipids fatty acids composition and desaturase activity in response to long-term linseed or sunflower oil diets. Methods: We used adult female C57/BL6 mice and randomly divided them into a control and two other groups treated with 25% linseed or sunflower oils in isocaloric diet conditions. Before treatment, we analyzed the fatty acid profiles in dietary oils and hepatocytes. After 100 days of oil diet, we analyzed the fatty acids composition in the liver through GC-chromatography. Results: Sunflower oil elevated total monounsaturated fatty acids (MUFA) due to the increase in palmitoleic, oleic, and vaccenic acids. Linseed oil elevated linolenic (ALA), eicosapentaenoic (EPA), and docosapentaenoic (DPA) acids and reduced arachidonic (AA) and docosatetraenoic (DTA) acids, reducing the n-6/n-3 ratio. The estimated activity of desaturase 9 was significantly elevated in the sunflower oil group. The estimated activity of desaturase 5 was the highest, while the estimated activity of desaturase 6 was the lowest in the mice treated with linseed oil. Discussion: We showed that long-term linseed or sunflower oil consumption affects the liver's phospholipids fatty acids composition in different ways. Sunflower oil could have beneficial effects on the liver tissue due to the increase in the total MUFA. Based on this and other studies, we conclude that the metabolism of n-3 PUFAs after linseed oil consumption is not sex-specific in the C57/BL6 mice model.

Keywords: phospholipids; fatty acids; long-term high-fat diet; linseed oil; sunflower oil

Author Contributions: S.R., T.P., and J.D.M. have written the manuscript. S.R. and J.D.M. have conducted experiments. A.T., A.S. and A.I. have supervised the work. A.N. and T.P. have performed statistical analyses. All authors have been involved in interpreting the results, contributed to drafting the discussion, and approved the final version of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Iron and Folate Intake in Pregnant and Non-Pregnant Women [†]

Joanna Suliburska *  and Rafsan Cholik



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Abstract: Iron and folic acid deficiency are common among women of childbearing age and in pregnant women. Poor iron and folate status in women is

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associated with an increased risk of anemia and disorders in the fetus development during pregnancy. The reason for the deficit of these micronutrients is improper nutrition and their low bioavailability. Incorrect eating habits before pregnancy are often continued during pregnancy. The aim of this study was to determine the intake of iron and folate with diet and supplements in non-pregnant and pregnant women in each trimester. The study was conducted on 50 non-pregnant women (NPW), 50 pregnant women in the first trimester (PW_1), 50 women in the second trimester (PW_2), and 44 women in the third trimester (PW_3), aged 19–42 years. We used a validated questionnaire and a 24 h recall nutrition interview. The results were analyzed using the computer software package Aliant. The BMI index was calculated (pre-pregnancy BMI in PW groups). Statistical analysis of the results was performed using Statistica 13.3. It was found that the average BMI was 23.5 kg/m² and was comparable between groups. The energy intake was significantly lower in the PW_2 group (1118 kcal) and markedly higher in the PW_3 group (1925 kcal). The intake of iron and folate from the diet was below RDA in all groups, and was significantly lower in the PW_1 group (27.4% RDA for iron and 23.7% RDA for folate) and markedly higher in the NPW group (55.5% RDA for iron and 66.3% RDA for folate). Only the use of supplementation resulted in an adequate intake of iron and folates, wherein the iron supplements were used by 14% of NPW, 46% of PW_1, 40% of PW_2, and 5% of PW_3, and folate supplements were as follows: 36%, 68%, 58%, and 23%, respectively, in the analyzed groups. In conclusion, the supply of iron and folates from the diet in non-pregnant and pregnant women is low (below 50% RDA in PW in each trimester and between 50 and 60% RDA in NPW). With such a low supply of these micronutrients, supplementation seems necessary for women.

Keywords: iron; folate; pregnancy; women

Author Contributions: Conceptualization, J.S.; methodology, J.S.; software, J.S.; validation, J.S. formal analysis, J.S.; investigation, J.S.; resources, J.S.; data curation, J.S. and R.C.; writing—original draft preparation, J.S. and R.C.; writing—review and editing, J.S.; visualization, J.S.; supervision, J.S.; project administration, J.S.; funding acquisition, J.S. All authors have read and agreed to the published version of the manuscript.

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The Effect of Gingko Biloba Extract and Zinc Supplementation on Iron Status in Diabetic Rats [†]

Ewelina Król * , Halina Staniek , Joanna Mikołajczyk-Stecyna  and Zbigniew Krejpcio 



Belgrade, Serbia, 14–17 November 2023.

Citation: Król, E.; Staniek, H.; Mikołajczyk-Stecyna, J.; Krejpcio, Z. The Effect of Gingko Biloba Extract and Zinc Supplementation on Iron Status in Diabetic Rats. *Proceedings* **2023**, *91*, 161. <https://doi.org/10.3390/proceedings2023091161>

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Abstract: Diabetes is a metabolic disease characterized by changes in carbohydrate and lipid metabolism. In turn, prolonged hyperglycemia may lead to increased oxidative stress and changes in the status of elements, including iron. Both ginkgo biloba extract (GBE) and zinc (Zn) may play a role in glycemic control. In this study, the effect of these ingredients both individually and in combination on the parameters of iron metabolism in diabetic rats was assessed. The experiment was carried out on male Wistar rats. The control group fed a standard diet (AIN-93M) was created, and in the rest of the rats diabetes was induced by feeding a high-fat diet and streptozotocin injection. Then, diabetic rats were divided into four groups: diabetic control, diabetic supplemented with Zn, diabetic supplemented with GBE, and diabetic supplemented with Zn and GBE. The doses of these supplements were 150 mg/kg diet for Zn and 0.8% for GBE, respectively. Rats were fed the diets for 6 weeks. During the autopsy, internal organs (liver, kidneys, spleen, pancreas, testis and heart) were collected. The content of Fe in tissues was determined by the AAS method followed by microwave digestion. Moreover, the serum ferritin concentration was measured. The significance of differences between the groups was analyzed by one-way analysis of variance and Tuckey's post-hoc test. The induction of diabetes resulted in a significant increase in Fe content in the pancreas and liver, as well as serum ferritin levels. Zn supplementation had no effect on the parameters studied. However, it was found that GBE alone and in combination with Zn significantly normalized the parameters studied in diabetic rats. In conclusion, GBE supplementation significantly improved the parameters of Fe metabolism, probably due to the fact that the extract contains compounds showing the ability to chelate iron ions.

Keywords: ginkgo biloba; zinc; diabetes; iron

Author Contributions: Conceptualization, validation, formal analysis, investigation, resources, data curation, writing—original draft preparation, funding acquisition—E.K., methodology—E.K., H.S., J.M.-S. and Z.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The experiment was conducted according to European Union (2010/63/EU) and approved by the Local Animal Care and Use Committee (3.01.2020, No. 49/2019).

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Conflicts of Interest: The authors declare no conflict of interest.

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Dietary Polyphenol Intake in Relation to Ultra-Processed Food Consumption in a Mediterranean Population-Based Cohort: Findings from the Moli-Sani Study [†]

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Intake in Relation to Ultra-Processed

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Abstract: Background and objectives: Ultra-processed foods (UPFs) have been consistently associated with the increased risk of premature mortality and diseases in numerous cohorts worldwide, possibly due to their poor nutritional composition. However, UPFs could also be deficient in several bioactive compounds, such as polyphenols, which are otherwise largely present in a variety of fresh foods, such as fruit, vegetables, and cereals. We therefore examined the dietary polyphenol content in relation to the degree of processing according to the Nova classification. Methods: The data were from the Moli-sani Study established in 2005–2010, including 22,939 men and women (mean age 55.4 y ± 11.7). Dietary data were collected using a 188-item food frequency questionnaire, and the polyphenol intake was calculated by matching the food consumption data with the Phenol-Explorer database regarding the polyphenol content of each reported food. NOVA classification was used to categorize the foods according to the levels of processing as unprocessed/minimally processed foods (e.g., fruits; meat) or UPFs (e.g., processed meat; packaged snacks). Results: The average (SD) weight contributions of the unprocessed/minimally processed foods and UPFs to the diet were 63.1% (±11.8) and 11.0% (±6.7), respectively. The mean intake of polyphenols was 665 (±265) mg/day. In multivariable-adjusted linear regression analysis controlled for the sociodemographic, behavioral and clinical factors, more UPF intake was associated with fewer dietary polyphenols ($\beta = -59.2$; 95% CI: from -62.1 to -56.3 mg/day of polyphenols for 1-SD increase in UPF). On the contrary, unprocessed/minimally processed food consumption was linked to more polyphenols in the diet ($\beta = 25.5$; 95% CI: 22.2 to 28.7). Discussion: In this large cohort of Italian adults, an increasing dietary share of UPFs would provide lower amounts of polyphenols in the diet, while consuming fresh and minimally processed foods is associated with a higher intake of polyphenols. Future studies are needed to test whether a low dietary polyphenol content has an effect on UPF–disease relationship.

Keywords: polyphenols; food processing; Nova classification

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Salicylate Intake in Pregnant and Non-Pregnant Women [†]

Joanna Suliburska * and Rafsan Cholik



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Salicylates are naturally present in plants. In medicine, acetylsalicylic acid (aspirin) is widely used as an analgesic, antipyretic, and anti-inflammatory agent and also as a preventive medicine for preeclampsia in pregnancy. The main sources of salicylates are vegetables, herbs, and spices. It

is observed that salicylates present in a diet rich in vegetables and herbs are largely responsible for the positive effects of these foods on human health. Therefore, the aim of this study was to determine the total salicylate intake in pregnant and non-pregnant women. This study was conducted on 105 non-pregnant women (NPW) and 98 pregnant women (PW) aged 19–42 years old. PW were at 11–12 weeks of gestation. We used a validated questionnaire and a 24 h recall nutrition interview. The results were analyzed using the original database on salicylate content in food and the computer software package Aliant. The BMI index was calculated. A statistical analysis of the results was performed using Statistica 13.3. It was found that in PW, the total intake of salicylates was significantly lower than in NPW as follows: $421.11 \pm 51.19 \mu\text{g/day}$ and $539.32 \pm 43.20 \mu\text{g/day}$, respectively. PW did not use supplements with salicylates nor aspirin, while 4.4% of NPW used supplements with salicylates, and 15% occasionally used aspirin. The main food sources of salicylates in women were as follows: spices, vegetables and fruits, and cereal products. However, PW used a significantly lower number of spices (especially hot spices) than NPW. In the NPW group, a good source of salicylates was alcohol (beer and wine), while PW did not drink alcohol at all. The energy intake in both groups was not markedly different and was $1612.81 \pm 314.07 \text{ kcal/day}$ in PW and $1552.40 \pm 321.18 \text{ kcal/day}$ in NPW. The average BMI of 22.8 kg/m^2 was comparable between groups. In conclusion, the intake of natural salicylates decreased in pregnancy, which may be associated with the lower beneficial effect of these bioactive substances on health in pregnant women, e.g., increasing the risk of preeclampsia.

Keywords: salicylates; aspirin; pregnancy; preeclampsia

Author Contributions: Conceptualization, J.S.; methodology, J.S.; software, J.S.; validation, J.S. formal analysis, J.S.; investigation, J.S.; resources, J.S.; data curation, J.S. and R.C.; writing—original draft preparation, J.S. and R.C.; writing—review and editing, J.S.; visualization, J.S.; supervision, J.S.; project administration, J.S.; funding acquisition, J.S. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data supporting the findings of this study are available on reasonable request from the corresponding author.

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Systematic Review and Meta-Analysis of Chicory Inulin-Type Fructans Supplementation on Weight Management Aspects [†]

Yoghatama Cindya Zanzer * and Stephan Theis 

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Abstract: Maintaining and reducing weight are considered as important features in reducing mortality and morbidity caused by metabolic-associated diseases. Increasing

evidence from in vivo mechanistic and clinical studies has shown that the gut microbiota is interacting with the host's physiological function in regulating energy intake and body weight. A prebiotic is a substrate that is selectively utilized by host microorganisms conferring a health benefit. Numerous clinical studies showed multifaceted benefits of prebiotic chicory inulin-type fructans (ITFs) on gut and metabolic health. The present systematic review and meta-analysis aimed to synthesize the totality of evidence through pooled estimates of ITF supplementation in supporting weight management on both healthy and diseased subjects. A systematic search for eligible articles was performed in databases (EMBASE, MEDLINE (PubMed), Web of Science) without a language restriction. Two reviewers independently extracted data from eligible articles. We chose primary (body weight) and secondary (BMI, total fat mass, body fat percentage and waist circumference) outcomes as weight management parameters. The baseline-corrected mean difference (MD) was used to synthesize the pooled effect size by employing a random-effects model using the inverse variance method. A sub-group analysis based on dose, duration, health status and ITF-type was also conducted. A total of 31 randomized controlled trials with 40 arms ($n = 1309$ participants) were included in this review. A significant reduction was observed on body weight (MD: -1.03 kg, 95% CI: -1.42 to -0.64 , $p < 0.0001$), BMI (MD: -0.39 kg/m², 95% CI: -0.58 to -0.21 , $p = 0.0001$), fat mass (MD: -0.45 kg, 95% CI: -0.71 to -0.2 , $p = 0.0023$), and waist circumference (MD: -0.99 cm, 95% CI: -1.61 to -0.37 , $p = 0.003$) following ITF supplementation. For body fat percentage, a significant effect was observed following subgroup analysis on an intervention that lasted for more than 8 weeks (MD: -0.78 percent, 95% CI: -1.17 to -0.39 , $p < 0.01$). The present meta-analysis of randomized controlled trials provides further evidence to support that ITF supplementation could help benefit weight management by reducing body weight, BMI, fat mass, waist circumference, and to a certain extent on body fat percentage.

Keywords: inulin-type fructans; weight management; meta-analysis; systematic review

Author Contributions: Conceptualization, Y.C.Z. and S.T.; methodology, Y.C.Z.; software, Y.C.Z.; validation, Y.C.Z. and S.T.; formal analysis, Y.C.Z.; investigation, Y.C.Z. and S.T.; resources, S.T.; data curation, Y.C.Z. and S.T.; writing—original draft preparation, Y.C.Z.; writing—review and editing, Y.C.Z. and S.T.; visualization, Y.C.Z.; supervision, S.T.; project administration, Y.C.Z. and S.T.; funding acquisition, S.T. All authors have read and agreed to the published version of the manuscript.

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Novel Drug and Nutraceutical Delivery System for the Treatment of Inflammatory Bowel Disease [†]

Aoife Murtagh ^{*ID}, Clement Higginbotham and Patricia Heavey ^{ID}



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Inflammatory bowel disease is a chronic condition

with no cure. However, there are a range of treatment options. Pharmacological approaches are usually the first step in treatment, and they are effective for many patients; however, for some, side effects are evident, and effectiveness can reduce overtime. Research on advanced delivery systems, new drugs and the therapeutic benefits of nutraceuticals such as curcumin have been previously investigated with promising results for IBD treatment, although they present their own unique challenges including poor bioavailability. The poor bioavailability of hydrophobic agents including curcumin is partly attributed to poor solubility and inadequate concentrations at target tissues. Therefore, the aim of the present work was to develop a novel pH-sensitive drug and nutraceutical delivery system featuring microspheres embedded in a hydrogel. Methods: Polylactic acid–polyethylene glycol microspheres loaded with dexamethasone (0.8 wt%) and curcumin (0.8 wt%) were synthesised using an emulsion solvent evaporation method. pH-sensitive polyethylene glycol dimethacrylate-co-acrylic acid hydrogels (46.6% and 33.3%, respectively) were synthesised with water (20%) by UV-photopolymerisation. The dexamethasone and curcumin microspheres were embedded into the hydrogels. Hydrogels and microspheres were characterised separately to understand their properties. Results: The encapsulation efficiency of the dexamethasone and curcumin microspheres was promising with higher encapsulation efficiency achieved for the curcumin microspheres (29% and 92%, respectively). Swelling studies demonstrated the equilibrium water content (EWC), the ability of the hydrogel to uptake its surrounding solution, with differences observed in response to changes in pH. In pH 6.8, hydrogels took up more of the surrounding solution compared to pH 2.2 (EWC% after 24 h = 69% and 56%, respectively). Gel fraction studies showed that the efficiency of the network formed during photopolymerisation (96%). Discussion: This targeted drug and nutraceutical delivery system may have the potential to play a role for IBD treatment with the combined impact of the microspheres in the hydrogel to be established. Dexamethasone and curcumin were encapsulated into microspheres which aid their solubility. The hydrogel component may help achieve a targeted delivery system, owing to the changes observed in response to different pH levels, as would be observed along the gastrointestinal tract.

Keywords: inflammatory bowel disease; delivery system; pharmacology; nutraceuticals; microspheres; hydrogels; treatment; management

Author Contributions: Conceptualization, A.M., C.H. and P.H.; methodology, A.M.; formal analysis, A.M.; data curation, A.M.; writing—original draft preparation, A.M.; writing—review and editing, A.M., C.H. and P.H.; supervision, C.H. and P.H.; funding acquisition, C.H. and P.H. All authors have read and agreed to the published version of the manuscript.

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The Effect of Adzuki Bean Extract on Antioxidant and Inflammatory Indices in Diabetic Rats [†]

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Małgorzata Gumienna ³ and Barbara Górna ³



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Abstract: One of the strategies used to alleviate metabolic disorders in diabetes is nutritional intervention. In order to achieve this goal, plant materials that contain compounds with high antioxidant potential, exhibit digestive enzyme inhibiting activity, or contain substances that improve insulin sensitivity are selected. The importance of legumes in the regulation of carbohydrate metabolism is currently the subject of many studies. Due to high α -glucosidase activity and phenolic profile, Adzuki bean (AB) may be considered as a plant with hypoglycemic and antioxidant properties. Thus, the aim of the study was to assess the effect of AB extract on antioxidant and inflammatory indices in diabetic rats. The experiment was conducted on male Wistar rats. The rats were divided into four groups; one was fed with the AIN-93M diet, while the other three were induced with diabetes by feeding them a high-fat diet for 4 weeks followed by intraperitoneal injection of streptozotocin (35 mg/kg b.w. in citrate buffer). The rats of the control group received citrate buffer alone. After confirmation of hyperglycemia, the rats were divided into three groups: diabetic control, diabetic fed diets supplemented with AB ethanolic extract with a lower dose (0.5%), and diabetic supplemented with AB extract with a higher dose (1%). The feeding period was 4 weeks. In serum, the glucose, CRP, TAS, SOD, CAT, and TBARS were determined. The inflammatory cytokines (TNF- α , IL-6) were measured in the liver and adipose tissue. In this study, induction of diabetes did not reveal strong inflammation in serum measured by serum CRP concentration ($p > 0.05$). However, in the liver, TNF- α and IL-6 increased, and a higher dose of AB extract normalized these indices. The serum TAS and activity of antioxidant enzymes (CAT, SOD, and ceruloplasmin) were unchanged in all experimental groups. On the other hand, CAT and SOD activity in the liver of diabetic rats decreased, and higher concentrations of AB extract normalized these values to a level comparable to the control group. In conclusion, the higher AB dose supplementation improved antioxidant potential and decreased inflammation in the liver of diabetic rats.

Keywords: Adzuki bean; diabetes; antioxidant; inflammation

Author Contributions: Conceptualization, E.K. and Z.K.; methodology E.K., H.S., D.S., M.G. and B.G.; validation, E.K.; formal analysis, E.K.; investigation, E.K., H.S., D.S. and B.G.; data curation, E.K.; writing—original draft preparation, E.K.; funding acquisition, E.K. and Z.K. All authors have read and agreed to the published version of the manuscript.

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Modulation of Gut Microbiota through Nutritional Interventions in Behçet's Syndrome Patients: Preliminary Results from the MAMBA Study[†]

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Abstract: Background. Recent evidence suggests that the gut microbiota (GM) in Behçet's syndrome patients (BS) has low diversity and a peculiar layout. Diet is known to influence the GM, but to date no study has investigated its effect on these patients. Aim. To evaluate the effect of a lacto-ovo vegetarian diet (VD) and a Mediterranean diet supplemented with 2 g/die of oral butyrate (MD-Bt) in comparison with a Mediterranean diet (MD) on the GM in BS. Methods. Forty-four (27F; mean age: 46.9 ± 11.2 years) BS patients were randomly assigned to follow a VD, MD-Bt, or MD for 3 months each and then crossed over. Stool samples were collected from the participants at the beginning and at the end of each intervention phase. Samples were analyzed through 16S rRNA amplicon sequencing on an Illumina MiSeq platform. Results. Regarding alpha diversity, a decreasing trend after a VD (Shannon index: $p = 0.069$; observed species: $p = 0.08$) and an increasing trend after a MD (Shannon index: $p = 0.084$; observed species: $p = 0.079$) were observed. Regarding beta diversity, no significant separation was found between the sample groups either over time or between different interventions. Phylum-level taxonomic analysis showed a significant increase in Bacteroidetes (+2.6%; $p = 0.049$) following the MD and a significant reduction in Proteobacteria (−0.2%; $p = 0.035$) following the MD-Bt. At the family level, we observed a significant increase in Bacteroidaceae (+2%; $p = 0.05$) and Porphyromonadaceae (+0.3%; $p = 0.004$) after the MD, a significant reduction in Porphyromonadaceae (−0.4%; $p = 0.05$) and Rikenellaceae (−0.7%; $p = 0.03$) after the VD, and a significant reduction in Rikenellaceae (−0.2%; $p = 0.008$) and Turicibacteraceae (−0.02%; $p = 0.04$) after the MD-Bt. In addition, there was a significant increase in the genus Bacteroides (+2%; $p = 0.05$) and Parabacteroides (−0.2%; $p = 0.004$) after the MD. On the other hand, the MD-Bt, led to a significant increase in Clostridium (+1%; $p = 0.05$) and a significant reduction in Oscillospira (−0.6%; $p = 0.011$) and Turicibacter (−1.9%; $p = 0.04$). Conclusions. The MD appeared to have an overall better impact on the GM modulation of BS in terms of higher diversity and potentially beneficial compositional changes.

Keywords: Behçet syndrome; gut microbiota; diet

Author Contributions: Conceptualization, G.P., G.E. and F.S.; methodology, G.P., S.T., G.E. and F.S.; formal analysis, G.P., F.D. and S.T.; investigation, G.P., I.M., M.T.A., G.E. and F.S.; writing—original draft preparation, G.P.; writing—review and editing, S.T., G.E. and F.S.; supervision, F.S. All authors have read and agreed to the published version of the manuscript.

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Association of Omega-3 Index and Blood Cell Count-Derived Systemic Inflammatory Indexes among Testicular Germ Cell Tumor Survivors [†]

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Association of Omega-3 Index and Blood Cell Count-Derived Systemic Inflammatory Indexes among Testicular Germ Cell Tumor Survivors.

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Abstract: Background and objectives: Although testicular cancer is considered the paradigm of highly curable malignancy, treatment-induced adverse effects and potential impairment of gonadal function may cause non-negligible long-term health repercussions, including metabolic disturbances and cardiovascular sequelae. This observational, cross-sectional study recruited a sample of testicular germ cell tumor survivors (TGCTs) attending routine follow-up care, with the aim to investigate the relationship between the Omega-3 Index, a promising cardiometabolic risk-assessment biomarker, and complete blood cell (CBC) count-derived systemic inflammation indexes. Methods: Erythrocyte membrane fatty acid (FA) profiling was performed by gas chromatography with flame ionization detection. The Omega-3 index (OI3) was computed by summarizing eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) expressed as a percentage of total FAs. Inflammatory indexes, including NLR (neutrophil-to-lymphocyte ratio), SII (systemic immune-inflammation index (platelet count × NLR)), SIRI (systemic inflammatory response index (monocyte count × NLR)), and AISI (aggregate index of systemic inflammation (monocyte count × SII)) were determined using routinely obtained hematological parameters. Results: In the analyzed cohort (n = 92, age \bar{x} = 35.89 ± 8.67 years), the mean value of OI3 was 4.41 ± 0.92%, where 53.26% of men were allocated the high-risk group (OI3 < 4%) and the rest were in the moderate cardiovascular hazard category (4% ≤ OI3 < 8%). The OI3 correlated inversely with the NLR, SII, and AISI (r = −0.234, −0.241, and −0.249, respectively, all p < 0.01). A negative association was determined between the total content of polyunsaturated fatty acids and SIRI (r = −0.221, p < 0.05). The NLR and AISI were statistically significantly lower in the subgroup of patients with OI3 ≥ 4% (p < 0.05). Discussion: Blood cell count-based inflammatory indexes may contribute to a more efficient risk stratification of TGCTs in relation to cardiometabolic disorders. Further large-scale research and long-term intervention trials are warranted to investigate the clinical significance of an increased intake of anti-inflammatory long-chain omega-3 polyunsaturated FA via dietary sources and/or supplementation in modulating the inflammatory process and reducing the morbidity burden in this patient population.

Keywords: testicular germ cell tumor; Omega-3 Index; systemic inflammatory indexes

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Study of Cardio-Metabolic Risk in Overweight and Obese People with Impaired Vitamin D Status [†]

Maria Nikolova * and Adriana Agovska



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Abstract: Background: Vitamin D deficiency increases cardio-metabolic risk through different mechanisms: activation of proinflammatory cytokines and

mediation of endothelial dysfunction, insulin resistance, accelerated atherosclerosis, etc. Objectives: To study and analyze the cardiovascular (cardiometabolic) risk in people with different levels of vitamin D. Methods: Laboratory and questionnaire data from 264 adults, mean age 41.19 years, were analyzed. The studied indicators were compared between people with deficiency and normal vitamin D levels, as well as between persons with normal and excessive BMI. Variation and correlation (Spearman's coefficient) were used. Results: It was established that vitamin D deficiency is related to some risk factors and cases of CVD. CVDs are significantly more common in people with vitamin D deficiency (15.9%) compared to 7.1% for those with a sufficiency of vitamin D and high blood pressure (36.4% compared to 27.4%). Overweight and obesity were found in 70.5% and 48.6% of those surveyed, respectively. Diabetes is present in 11.8% of people with vitamin D deficiency, compared to 4.3% in people with vitamin D sufficiency. Survey data show that people with vitamin D deficiency have more often followed a diet in the last year (74.1% compared to 55.7%), most often low-calorie (17.0%), followed by protein (Dukan) (8.0%), low-carbohydrate (4.5%), and starvation (4.5%). Diet is a modifiable risk factor in the prevention of CVD, but the “weight cycle” effect increases the risk of developing and maintaining cardio-metabolic risk and diseases. In persons with an excessive BMI, there has been a significantly more frequent change in weight in the last year: 59.4% compared to 30.6% in the control group ($p < 0.001$). Weight gain was 5.53 kg versus 2.43 kg and was associated with an increased risk of CVD regardless of BMI. Discussion: The study shows that there is an increased cardiovascular risk in people with vitamin D deficiency, which increases if combined with an excessive BMI. Diet and weight variation are important triggers for the occurrence and development of CVD in various BMI and metabolic disorders.

Keywords: vitamin D; cardio-metabolic risk; obesity

Author Contributions: Conceptualization, M.N. and A.A.; software, A.A.; validation, M.N. and A.A.; formal analysis, M.N.; investigation, M.N.; resources, A.A.; data curation, M.N.; writing—original draft preparation, A.A.; writing—review and editing, M.N.; visualization, M.N.; supervision, M.N.; project administration, M.N.; funding acquisition, M.N. All authors have read and agreed to the published version of the manuscript.

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High-Protein Diets Have the Potential to Reduce Gut Barrier Function in a Sex-Dependent Manner [†]

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Abstract: Increased intestinal permeability is linked to low-grade systemic inflammation associated with chronic diseases. Undigested dietary proteins reach the colon, where they are fermented by components of the gut microbiota to produce metabolites shown to increase intestinal permeability in vitro. As evidence for sex differences in the microbiota grows, we hypothesised that the effects of the microbial fermentation of protein would also be sex-dependent. Thus, our objective was to determine whether there were sexual dimorphisms in microbial composition and metabolic output following the fermentation of different proteins using in vitro human gut model systems. Faeces from healthy male ($n = 5$) and female ($n = 5$) donors were used to inoculate gut fermentation systems supplemented with non-hydrolysed proteins (0.9 g) derived from whey, fish, milk, soya, mycoprotein, egg or pea. At 0, 8, 24 and 48 h, the microbiota composition was quantified using fluorescence in situ hybridisation coupled with flow cytometry, while bacterial-derived metabolite production was assessed via gas chromatography/mass spectroscopy and an ELISA. Increased protein availability resulted in significant increases in proteolytic *Bacteroides* spp. ($p < 0.01$) and *Clostridium* coccoides ($p < 0.01$) and significant increases in the production of potentially detrimental metabolites including phenol ($p < 0.01$), *p*-cresol ($p < 0.01$), indole ($p = 0.018$) and ammonia ($p < 0.01$), all of which were highly dependent on protein type. Furthermore, we showed higher abundances of *Clostridium* cluster IX ($p = 0.03$) and concentrations of *p*-cresol ($p = 0.025$) at 24 h in males, while females produced more ammonia ($p = 0.02$) irrespective of the protein source. The fermentation of mycoprotein resulted in significantly higher abundances of *Clostridium* cluster IX in males at 8 and 24 h compared to females ($p < 0.01$). There were also significant interactions between sex, protein source, bacterial populations and bacterial-derived metabolic-end-product concentrations. Our study provides new evidence that the effects of the microbial fermentation of dietary proteins in vitro are highly dependent on the source of the protein and the sex of the donor. Consequently, we suggest that different proteins are likely to have differential impacts on intestinal barrier function in vivo, and these effects may be different in males and females. If corroborated in human studies, our results would have important implications for dietary recommendations to limit chronic diseases.

Keywords: dietary protein; gut microbiota; sexual dimorphisms



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metabolite analyses. J.S.E. conducted the phenolic compound analysis using SPME-GCMS and wrote the methods section for this specific measurement. D.J. and M.C.L. wrote the main manuscript text and prepared all figures. All authors have read and agreed to the published version of the manuscript.

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The Big Poo Review: A ZOE Health Study Deep Dive into the UK's Bowel Habits [†]

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Abstract: Background: Bowel habits remain under-studied despite their associations with chronic diseases and their impact on quality of life. We aimed to elucidate the pattern of bowel habits in the UK and investigate gender differences and dietary associations. Methods: A UK populationbased survey, “The Big Poo Review,” involving 142,765 participants, was conducted in the ZOE Health Study (LRS/DP-20/21-25809). Respondents completed a 37-item bowel habit questionnaire.

Diarrhoea was defined as evacuation >3 times/day or passing Bristol Stool scale (BSS) type 6 or 7 > 25% and constipation was defined as evacuation <3 times/wk or passing BSS type 1 or 2 > 25%. Participants (n = 26,703) who completed a food frequency questionnaire within 5 months of the study were included in the subgroup dietary analysis. Results: Participants were predominantly female (77%) with a mean age of 57.8 years (IQR: 50–67). The most frequently reported bowel pattern was a single daily bowel movement (54%) after breakfast (60%) and BSS type 4 (40%). The mean defecation frequency was 1.7 times/day (SD 0.9), but 0.4% of participants defecated <1 time/wk and 1.4% defecated >4 times/day. Constipation was reported in 21.0% (women 23.3%, men 13.0%; $p < 0.001$) and diarrhoea in 15.3% (men 17.5%, women 14.7%; $p < 0.001$). Those with diarrhoea or constipation consumed significantly fewer legumes, nuts, and seeds (12 g and 7 g/day less, respectively), fruits (14 g and 18 g/day less, respectively), and vegetables (14 g and 30 g/day less, respectively) than those without ($p < 0.01$ for all comparisons). Dairy intake was different between all three groups (constipation 276 g/day; diarrhoea 256 g/day; regular stools 267 g/day; $p < 0.001$ for all comparisons). Discussion: This survey is the largest study of UK bowel habits to date, highlighting gender and dietary differences in habits. The high prevalence of constipation and diarrhoea underscores the need for focused public health efforts and potential nutrition interventions.

Keywords: bowel habits; diarrhoea; constipation

Author Contributions: Conceptualization, S.B., J.W., T.S. and W.B.; methodology, W.B. and I.L.; formal analysis, A.P.; data curation, A.P. and W.B.; writing—original draft preparation, K.B.; writing—review and editing, S.B., T.S. and W.B.; All authors have read and agreed to the published version of the manuscript.

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Improvement in Vitamin D Status and Long-Term Incidence of Type 2 Diabetes in the General Finnish Population—Evidence Based on Cohort and Register Datasets [†]

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Maijaliisa Erkkola ¹ and Christel Lamberg-Allardt ¹



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Large improvements in vitamin D status (serum 25-hydroxyvitamin D; S-25(OH)D) have been recorded among the general Finnish population, mainly due to vitamin D fortification policies and supplement use. Vitamin D intake has increased since the beginning of the fortification scheme in 2003 and subsequently by its increment in 2010. Also, vitamin D supplement use has increased over the years. However, whether sufficient vitamin D status lowers the risk of diabetes is unclear. Hence, we investigated the association between the improved vitamin D status in the Finnish adult population and long-term incidence of type 2 diabetes (T2D). Methods: This study evaluated data of Finnish adults aged ≥30 years ($n = 3014$) in a longitudinal setting (Health 2000/2011 cohort) who did not have T2D at baseline. The S-25(OH)D concentrations from both time points (years 2000 and 2011) were standardized according to the Vitamin D Standardization Program. The survey datasets were linked with incident T2D datasets from the national register for the time period 2000–2019. Associations between vitamin D status, change in S-25(OH)D concentrations and incidence of T2D over the 8-year follow-up period were assessed using logistic and Cox regression models (adjusted for age, sex and blood sampling season, etc.). Results: Over the 8-year follow-up period, 214 T2D incident cases were observed in subjects who participated in both Health 2000 and Health 2011. We observed a borderline significantly lower mean baseline S-25(OH)D concentration among T2D cases (45.4 [SD = 12.3] nmol/L) compared with participants not having T2D (48.1 [SD = 134.6] nmol/L) ($p = 0.01$). Having a sufficient vitamin D status (S-25(OH)D ≥50 nmol/L) at baseline was associated with lower odds of T2D (adjusted OR 0.94 [95% CI 0.89–0.98]). In participants whose S-25(OH)D concentrations increased over the years, the T2D incidence was lowered (adjusted HR 0.01 [95% CI 0.00–0.01] and 0.82 [95% CI 0.76–0.89] for $\Delta \geq 50$ nmol/L). Discussion: Our preliminary findings indicate a protective effect of increased 25(OH)D (up to 50 nmol/L) against T2D among Finnish adults with an initially low vitamin D status. This study shows that well-designed longitudinal cohorts using standardized methods carry valuable potential to evaluate national nutrition status and to investigate the relationship between nutrition status and chronic diseases.

Keywords: vitamin D status; type 2 diabetes; cohort; register, 25-hydroxyvitamin D

Author Contributions: Conceptualization, F.A.A., S.T.I., M.E. and C.L.-A.; methodology, T.J., T.H. and K.D.C.; validation, T.J., T.H. and C.L.-A.; formal analysis, F.A.A.; data curation, T.J.; writing—original draft preparation, F.A.A.; writing—review and editing, F.A.A., S.T.I., T.H., M.E. and C.L.-A.; supervision,

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Institutional Review Board Statement: Both surveys (Health 2000/2011) were conducted in accordance with the Declaration of Helsinki. The protocol for Health 2000 was approved by the Ethical Committee for Research in Epidemiology and Public Health, while Health 2011 was approved by the Coordinating Ethics Committee at the Hospital District of Helsinki and Uusimaa in Finland. Ethics approval for the usage and linkage of survey datasets to national registers was obtained from the Finnish Institute for Health and Welfare.

Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Restrictions apply to the availability of these data. Data was obtained from the Finnish Institute for Health and Welfare with permission (<https://thl.fi/en/web/thlfi-en/research-and-development/research-and-projects/health-2000-2011>).

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Carbohydrate (CHO) Intake and Quality during Adolescence and Association with HOMA2-IR in Adulthood—The Role of the Chronotype [†]

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Abstract: Background/objectives: Adolescence is associated with two risk markers of Type 2 Diabetes Mellitus (T2DM): insulin resistance and lateness in chronotype. Hence, negative eating behavior during adolescence may increase the future risk of T2DM. We investigated the prospective relevance of carbohydrates (CHO) from high GI sources consumed in the morning and in the evening during adolescence for HOMA2-IR in young adulthood and the role of chronotypes. Methods: Examinations of subjects were performed at the DONALD study centre. Participants provided at least two 3-day weighed dietary records (median = 7 records) during adolescence and one blood sample in young adulthood. CHO quality was classified as low (<55) and moderate (≥55) according to the Glycemic Index. Chronotype was assessed with the Munich Chronotype Questionnaire and defined as age and sex-adjusted midpoint of sleep on free days corrected for sleep debt on workdays (MSFsc) using all measurements from adolescence up to young adulthood, applying regression analyses. Earlier and later chronotypes were based on the averaged median values of MSFsc. We used the HOMA2 calculator (University of Oxford) to define HOMA2-IR from fasting insulin and glucose measures. Multivariable regression analyses (including, e.g., age, sex, BMI-SDS, physical activity and energy) assessed the longitudinal associations of interest. Testing for trend calculations were based on median values per tertile. We assessed interactions by chronotype and additionally stratified the data according to chronotype. Results: A total of N = 224 (♀n = 58%) participants with a median (Q1:Q3) age of 12 (12:13) yrs during adolescence and 22 (18:26) yrs at blood withdrawal were included. Stratified analyses by chronotype were not different and there was no significant interaction ($p > 0.05$). Only the residual of adolescent CHO consumption in the morning (<11:00 hh:mm) was significantly, inversely associated with adult HOMA2-IR (Ismans HOMA2-IR T1: 2.96 (2.41–3.55) vs. T3: 1.95 (1.54–2.41), p for trend = 0.01). Discussion: Our data suggest that the consumption of CHO in the morning decreases HOMA2-IR independent of chronotype. The results presented in this article are part of a research project funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation)-AL 1794/1–2.

Keywords: carbohydrates; glycemic index; adolescents; chronotype; type 2 diabetes mellitus



Author Contributions: U.A. and research; S.A.W. was responsible for immunoradiometric insulin measurements; N.J. analyzed data and A.B. conceptualized the performed statistical analysis and

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wrote the abstract; All authors reviewed and edited the abstract and contributed to the interpretation and discussion of the results and approved the final abstract. N.J. had primary responsibility for the final content. Project Administration, N.J.; Funding Acquisition, U.A. and A.B. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study design of the DONALD study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the University of Bonn (protocol code: 185/20 and date of approval: 29 April 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data of the DONALD study is available upon reasonable request to epi@uni-bonn.de.

Conflicts of Interest: Anette Buyken is a member of the International Carbohydrate Quality Consortium (ICQC), and a co-author of the popular cookbook “Nordisch abnehmen”.

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Partial Least Square–Cox Regression to Investigate Association between Patterns of Dietary Exposure to Persistent Organic Pollutants and Breast Cancer Risk in the E3N Cohort [†]

Pauline Frenoy ^{1,*} , Francesca Mancini ¹ and Vittorio Perduca ²



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polychlorinated biphenyls (PCBs), per- and polyfluoroalkyl substances (PFASs), brominated flame retardants (BFRs) and polycyclic aromatic hydrocarbons (PAHs), was estimated using food consumption data, collected through a validated semi-quantitative food frequency questionnaire, and food contamination data, as measured in the second French Total Diet Study. ER-positive BC cases were identified through self-administered questionnaires, from next-of-kin spontaneous reports, or through information from the national cause-of-death registry. Partial least square–Cox regression (PLS–Cox), a supervised dimension reduction method, was used to identify POPs patterns associated with ER-positive BC occurrence. Cox proportional hazard models were then used to estimate hazard ratios (HRs) and their 95% confidence intervals (CIs) for the associations between the PLS–Cox patterns retained and the risk of ER-positive BC, adjusted on potential confounders identified using a directed acyclic graph. The women were followed for a maximum of 21.4 years, and 5,686 developed incident ER-positive BC. Based on POP intake estimates, five patterns were retained. The first pattern was characterized by positive weights for almost all POPs, especially PAHs and some dioxins. The other principal components were characterized by both positive and negative weights. A significant non-linear and non-monotonic association was highlighted between exposure to the first pattern and ER-positive BC risk, and significant positive linear associations were highlighted between exposure to the second, fourth and fifth patterns and ER-positive BC risk. The use of the PLS–Cox method allowed the identification of relevant patterns in POPs explaining, as far as possible, the covariance between the exposures and the outcomes. Identifying such patterns can help to better clarify the pollutants involved in BC occurrence and to estimate their cumulative effect.

Abstract: Exposure to persistent organic pollutants (POPs) is suspected to play a role in the occurrence of estrogen receptor-positive breast cancer (ER-positive BC). Our objective was to investigate the association between patterns of dietary exposure to POPs and ER-positive BC risk in the E3N cohort. The study included 67,879 women. The intake of 81 POPs, including dioxins,

Keywords: persistent organic pollutants; breast cancer; partial least square regression

Author Contributions: Conceptualization, F.M., V.P. and P.F.; methodology, F.M., V.P. and P.F.; formal analysis, P.F.; writing—original draft preparation, P.F.; writing—review and editing, F.M. and V.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: All participants gave written informed consent.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.






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Abstract

Ultra-Processed Food Consumption and Biological Aging in Italian Adults from the Moli-Sani Study Cohort [†]

Simona Esposito ¹, Alessandro Gialluisi ², Augusto Di Castelnuovo ³, Simona Costanzo ¹, Emilia Ruggiero ¹ , Licia Iacoviello ^{1,2,*}  and Marialaura Bonaccio ¹ 



from the Moli-Sani Study Cohort. *Proceedings* **2023**, *91*, 97. <https://doi.org/10.3390/proceedings2023091097>

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Abstract: Background and objectives: Chronological age (CA) may not accurately reflect

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the health status of an individual. Rather, biological age (BA) or hypothetical underlying “functional” age has been proposed as a relevant indicator of healthy aging. Diets high in polyphenol-rich foods, such as the Mediterranean diet, were inversely associated with biological aging in several cohorts. However, the nutritional content is only one aspect of overall food health potential, and increasing attention should be paid to non-nutrient food characteristics, such as food processing. Ultra-processed foods (UPFs) are mostly industrial formulations designed to maximize palatability and consumption through a combination of calorie-dense ingredients and chemical additives, and have been consistently associated with the increased risk of premature mortality and diseases. We therefore examined the association of UPF with biological aging. Methods: A cross-sectional analysis of a sub-cohort of 4510 subjects (aged ≥ 35 years; 52.0% women) enrolled in the Moli-sani Study (2005–2010). Food intake was assessed using a 188-item food frequency questionnaire. UPF was defined according to the Nova classification and calculated as the ratio (%) of UPF (g/d) to total food consumed (g/d), and categorized into sex-specific quintiles. Diet quality was assessed using the Food Standards Agency Nutrient Profiling System (FSAm-NPS) dietary index. A Deep Neural Network approach based on 36 circulating biomarkers was used to compute BA, and the resulting difference ($\Delta\text{age} = \text{BA} - \text{CA}$) was tested as a dependent variable in multivariable linear regression analyses including known risk factors. Results: The mean CA (SD) was 55.6 y (± 11.6 years), BA 54.8 y (± 8.6 years), and $\Delta\text{age} -0.77$ (± 7.7). In multivariable-adjusted analyses also including the FSAm-NPS dietary index, a higher intake of UPF consumption was directly associated with accelerated biological aging ($\beta = 0.61$; 95%CI 0.05 to 1.17 for Q5 vs. Q1). Discussion: High UPF consumption was directly associated with a blood-markers-based measure of biological aging, independent of overall diet quality. These findings suggest that biological aging could be influenced by non-nutrient food characteristics (e.g., altered food matrix, contact materials and neoformed compounds). Longitudinal studies are warranted to examine whether accelerated biological aging could fall on the pathway between UPF consumption and chronic disease onset.

Keywords: ultra-processed foods; biological age; diet quality

Author Contributions: Conceptualization, S.E. and M.B.; methodology, A.G.; formal analysis, S.E., A.D.C. and A.G.; data curation, S.C. and E.R.; writing—original draft preparation, S.E.; writing—review and editing, M.B.; supervision, L.I.; project administration, L.I.; funding acquisition, L.I. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The Moli-sani study was granted the approval of the Ethics Committee of the Catholic University in Rome, Italy, ID Prot. pdc. P.99 (A.931/03-138-04)/C.E./2004. **Informed**

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An Unhealthy Dietary Pattern-Related Metabolic Signature Is Associated with Cardiometabolic and Mortality Outcomes: A Prospective Analysis of the UK Biobank Cohort [†]

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Abstract: Background and objectives: An unhealthy dietary pattern (DP) previously identified in the UK Biobank population was positively associated with incident cardiovascular disease (CVD), type 2 diabetes (T2D) and mortality. Differences in individuals' metabolic responses to this DP may help identify novel pathways explaining the observed associations. This study aimed to identify metabolomic signatures characterising adherence to the DP and to investigate prospective associations with cardiometabolic and mortality outcomes. Methods: A cohort of n = 102,862 UK Biobank participants was studied, of which n = 28,123 participants with data on the DP of interest (derived from 2 or more 24 h dietary assessments at baseline) and available metabolomic data (n = 119 metabolites) were used to construct a DP-related metabolic signature score (DPMS) reflecting adherence to the previously identified DP. Metabolomic data were obtained from randomly selected EDTA plasma samples collected at baseline using a high-throughput NMR-based profiling platform. A sparse partial least squares (sPLS) model was used to compute the coefficients needed to calculate the DPMS. Multivariable Cox-proportional hazard models were used to investigate prospective associations between the DPMS and CVD, T2D and mortality outcomes in all participants with available metabolomic data. Results: A DPMS consisting of 46 differential metabolites was calculated, characterised by higher plasma levels of creatinine, saturated fatty acids and sphingomyelins, but lower levels of docosahexaenoic acid, omega 3 and 6 fatty acids and linoleic acids. During an average of 12 years of follow-up, 10,236 cases of total CVD, 5675 cases of T2D and 6367 cases of all-cause mortality were observed in the study sample (mean age 56 years; 55% women). We found significantly positive associations between the DPMS and total CVD events (hazard ratio [HR] per z-score increment = 1.16 [95%CI 1.14–1.18]) and between the T2D (HR per z-score increment = 1.24 [95%CI, 1.22–1.26]) and all-cause mortality (HR per z-score increment = 1.13 [95%CI, 1.10–1.15]). Conclusions: A newly identified metabolic signature reflecting higher adherence to an unhealthy dietary pattern was characterised by metabolites that indicated a poor lipid metabolism. This metabolic signature showed stronger associations with cardiometabolic and mortality outcomes than those observed previously with traditional dietary pattern measurements. Keywords: dietary pattern, plasma metabolomics, cardiometabolic outcomes, mortality, cohort study.

Keywords: dietary pattern; metabolomics; health outcomes; cohort study

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Author Contributions: Conceptualization, A.T.-M., A.A.-R., O.R.-H., C.M.A. and C.P.; methodology, A.T.-M., A.A.-R., O.R.-H., C.M.A. and C.P.; formal analysis, A.T.-M., A.A.-R., O.R.-H. and C.P.; writing—original draft preparation, A.T.-M. and C.P.; writing—review and editing, A.T.-M., A.A.-R., O.R.-H., C.M.A. and C.P.; funding acquisition, C.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: At recruitment, all participants gave informed consent to participate and be followed-up through data-linkage.

Data Availability Statement: This research was conducted using the UK Biobank resource under application number 14990. Data can be obtained upon application to the UK Biobank.

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No Difference in the Effects of Consuming Commercially Relevant Palmitic Acid- and Stearic Acid-Rich Interesterified Fats on the Plasma Total Cholesterol to High-Density Lipoprotein Cholesterol Ratio: The INTER-SAT Study [†]

Wendy L. Hall ^{1,*} , Eleanor Wood ¹, Peter J. Joris ² , Johanna H. Bruce ³, Ronald P. Mensink ² and Sarah E. Berry ¹



Citation: Hall, W.L.; Wood, E.; Joris, P.J.; Bruce, J.H.; Mensink, R.P.; Berry, S.E.

No Difference in the Effects of

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Total Cholesterol to High-Density

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Abstract: Background and Objectives. Randomly interesterified (IE) palmitic acid (16:0)- and stearic acid (18:0)-rich fats are commonly used by the food industry for applications such as spreads and bakery products. Previous studies demonstrate that 18:0-rich fats (unlike 16:0-rich) do not increase the total:HDL cholesterol ratio (TC:HDL), but the comparative effects of commercially relevant IE fats rich in 16:0 or 18:0 are unclear. Hypothesis: An IE 16:0-rich fat will have equivalent effects on the TC:HDL when compared with a functionally matched 18:0-rich fat. Methods. A randomised crossover trial

(clinicaltrials.gov NCT04418102; funded by the Malaysian Palm Oil Board) in healthy adults aged 35–65 was conducted. IE fats provided 10% energy intake for 6 weeks per arm with a minimum 4-week washout period. IE fats were formulated into hardstocks that were baked into muffins and blended into spreads. Spreads contained either 54% IE palm stearin/kernel (PSK) hardstock (16:0, 49%; 18:0, 5%) blended with 36% rapeseed oil (final spread: 16:0, 32%; 18:0, 4%), or 54% IE fully hydrogenated rapeseed oil/coconut oil/high oleic sunflower oil/sunflower oil hardstock (16:0, 7%; 18:0, 41%) blended with 36% rapeseed oil (final spread: 16:0, 6%; 18:0, 25%). The study was conducted at King's College London and Maastricht University. Results: A total of 51 eligible volunteers were randomised to the treatment sequence; 47 participants completed the study (24 females/23 males; mean age 52 years, SD 8; mean BMI 25.6, SD 3.0). The TC:HDL did not change following FHS (0.03,

95% CI –0.06, 0.12) or PSK (–0.03, 95% CI –0.11, 0.06) and changes did not differ between groups (0.05, 95% CI –0.08, 0.18). The total, HDL and LDL cholesterol and triglyceride concentrations did not change following PSK or FHS and there were no differences in changes between groups. Discussion: Consuming foods made with commercially relevant IE fat blends rich in 16:0 at 10% of the energy intake is unlikely to have a detrimental effect on the TC:HDL when compared with IE fat blends rich in 18:0. These results provide much-needed evidence of the cardiometabolic health effects of industrially processed fats relevant to oil and fat manufacturers, the food industry, health authorities and healthcare professionals.

Keywords: saturated fatty acids; cholesterol; lipids; randomised controlled trial

Author Contributions: Conceptualization, S.E.B. and R.P.M.; methodology, S.E.B., R.P.M., P.J.J., J.H.B. and W.L.H.; formal analysis, W.L.H.; investigation, E.W. and P.J.J.; data curation, E.W. and P.J.J.; writing—original draft preparation, W.L.H.; writing—review and editing, S.E.B., J.H.B., R.P.M. and P.J.J.; funding acquisition, S.E.B. All authors have read and agreed to the published version of the manuscript.

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January 2020) and Medical Ethics Committee of Maastricht University (METC 19-032, October 2019).

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Associations of Circulating Gamma-Linolenic Acid and Cardiometabolic Health in Chinese Adults: A Prospective Study [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: Previous studies have shown that dietary and circulating n-6 polyunsaturated fatty acids (n-6 PUFAs) have beneficial associations with cardiometabolic health in humans. However, some studies showed inconsistent associations between circulating gamma-linolenic acid (GLA, C18:3 n-6), a metabolite of linoleic acid (LA, C18:2 n-6), and cardiometabolic health compared to LA. Therefore, this study aimed to examine the associations of erythrocyte GLA proportions with the presence and incidence of cardiometabolic diseases in Chinese adults. Methods: This prospective study included 3591 participants (40–80 years) from the Guangzhou Nutrition and Health Study, South China. The participants were recruited from 2008 to 2013 and followed up every 3 years. Erythrocyte fatty acids were determined using the baseline samples. Assessments of metabolic syndrome (MetS), carotid intima-media thickness, blood lipids, and questionnaire interviews were conducted at each visit. The associations between erythrocyte GLA and the presence and incidence of MetS, carotid artery plaque (CAP), and coronary heart diseases (CHD) were analyzed using logistic and Cox regression models after adjusting for potential covariates. Results: Among the 3591 participants at baseline, 1155, 941, and 417 had MetS, CAP, and CHD, which were included in the cross-sectional analyses. After a median of a 9-year follow-up, 935/2436, 1172/2203, and 524/2507 participants (case N/total N followed up) developed MetS, CAP, and CHD and were included in the prospective analyses, respectively. Multivariate-adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) of MetS, CAP, and CHD for the quartile (Q) 4 (vs. 1) of GLA were 3.11 (2.50, 3.87), 1.25 (0.99, 1.58), and 1.54 (1.12, 2.13) (all *p*-trends < 0.05). The corresponding hazard risks (HR) and 95% of the CIs of the 9-year incidences were 1.45 (1.20, 1.75), 1.25 (1.06, 1.48), and 1.40 (1.10, 1.80) (all *p*-trends < 0.05), respectively. However, LA showed beneficial associations with MetS presence (Q4 vs. Q1, OR: 0.65, 95% CI: 0.53, 0.80) and the 9-year CAP incidence (Q4 vs. Q1, HR: 0.78, 95% CI: 0.66, 0.92) (*p*-trends < 0.01). Conclusions: Our findings show a detrimental association between erythrocyte GAL and the presence and incidence of MetS, CAP, and CHD in Chinese adults. Experimental studies are needed to confirm the causal relationship.

Keywords: gamma-linolenic acid; metabolic syndrome; carotid artery plaque; coronary heart diseases; prospective study

Author Contributions: Study conception and design: Y.-M.C.; Obtaining funding: Y.-M.C.; Acquisition of data: H.-L.Z., Y.Y., Y.-D.Y., H.-Z.C., and T.-Y.S.; Data analysis and interpretation: H.-L.Z. and Y.-M.C. Writing of report: Y.-M.C. All authors have read and agreed to the published version of the manuscript.

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Combination of Adherence to a Traditional Mediterranean Diet and Ultra-Processed Food Consumption in Relation to All-Cause and Cardiovascular Mortality: Prospective Findings from the Moli-Sani Study [†]

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Combination of Adherence to a Traditional Mediterranean Diet and Ultra-Processed Food Consumption in Relation to All-Cause and Cardiovascular Mortality:

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Abstract: Background and objectives: The Mediterranean Diet (MD) has been consistently associated with lower mortality in cohort studies worldwide. Ultra-processed foods (UPF) are increasingly displacing nutritious traditional diets, with alarming health results globally. We examined the combined association of an MD and UPF consumption in relation to all-cause and cardiovascular disease (CVD) mortality in a cohort of Italian adults. Methods: Longitudinal analyses on 22,895 participants of the Moli-sani Study (2005–2010) followed for 12.2 years (median). Food intake was assessed using a 188-item FFQ. UPF was defined following the NOVA classification and calculated as the ratio (weight ratio; %) between UPF (g/d) and total food (g/d). The Mediterranean Diet Score (MDS; range 0–9) was used to assess adherence to MD. Low/High MD adherence (i.e. MDS < 6 or ≥ 6, respectively) was combined with low/high UPF consumption (i.e. < 9.4 or ≥ 9.4% corresponding to the population’s median intake of UPF) to obtain a 4-level dietary variable reflecting dietary combinations from ‘low MD and high UPF’ to ‘high MD and low UPF’. Results: In multivariable-adjusted analysis controlled for known risk factors, compared to the ‘low MD and high UPF’ combination, taken as reference, the ‘high MD and low UPF’ combination had a significant 24% lower rate of all-cause mortality (Hazard ratio = 0.76; 95% CI 0.67–0.86). Participants reporting both “low MD and low UPF” had a significant but only 15% lower death rate (Hazard ratio = 0.85; 0.77–0.95), while individuals consuming both “high MD and high UPF” had a 4% not significant lower death rate (Hazard ratio = 0.96; 0.80–1.14; *p*-value for difference across groups < 0.001; *p*-value for interaction between MD and UPF = 0.47). Similar results were found for CVD mortality, with highest protection observed in the ‘high MD and low UPF’ dietary combination group (Hazard ratio = 0.74; 0.60–0.92) as compared to the reference combination. Discussion and conclusions: The combination of both high adherence to an MD and low UPF intake was associated with lowest all-cause and CVD death rate; the effects of both dietary exposures were additive. Besides the adoption, or maintenance, of an MD, dietary guidelines should also recommend to contextually reduce the dietary share of UPF to maximize Mediterranean diet-related health benefits.

Keywords: Mediterranean Diet; ultra-processed food; survival; cardiovascular mortality

Author Contributions: Conceptualization, M.B. and A.D.C.; methodology, M.B. and A.D.C.; validation, S.C.; formal analysis, M.B.; data curation, S.C. and E.R.; writing—original draft preparation,

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Abstract

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Abstract

Adherence to a Mediterranean Diet and Risks of Alzheimer and Parkinson Diseases: A Systematic Review of Population-Based Studies [†]

Sukshma Sharma ^{1,*}, Alessandro Gialluisi ^{1,2}, Maria Benedetta Donati ¹, Giovanni de Gaetano ¹,
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Abstract: Background and objectives: Diet is suggested as a major modifiable risk factor for neurodegenerative diseases, but there is conflicting and inadequate evidence regarding whether adherence to a Mediterranean diet (MD) is associated with lower risks of Alzheimer Disease (AD) and Parkinson Disease (PD). We performed a systematic review of available population-based studies to disentangle the association between MD and risk of AD or PD. Methods: PubMed, MEDLINE, Embase and Scopus were searched for relevant articles published from inception until April 2023. Only observational cohort studies, prospective studies, and case–cohort studies were included to explore the longitudinal association between adherence to an MD and the risk of AD and PD. Studies with adult participants (>18 years old) were included if they explored and reported results on MD, along with other dietary patterns, and examined MD using the following definitions: ‘Medi Score diet’ and ‘alternate Mediterranean diet index (aMED diet)’. Results: A total of three studies (two longitudinal and one case–control) on AD were identified out of 1233 records, and five studies on PD (three longitudinal and two case–control) out of 320 records were identified. For AD, all three studies reported an association between a higher adherence to an MD and a lower risk of AD, with values ranging from 9% (Hazard ratio, 0.91; 95% confidence interval, 0.83–0.98; $p = 0.015$) to 54% (Hazard ratio = 0.46, 95% CI 0.26, 0.79, $p = 0.01$). For PD, three out of five studies reported that a higher adherence to MD was associated with a lower risk of PD, with values ranging from 11% (Hazard ratio = 0.89; 95% CI 0.74–1.07) to 46% (Hazard ratio = 0.54; 95% CI 0.30–0.98). Conclusions/Discussion: The overall longitudinal findings suggested that a high adherence to an MD was inversely associated with the risks of AD and PD, and might be beneficial for nutrition strategies and clinical treatment. However, further epidemiological studies are warranted to increase the generalizability of the findings and to better understand the longitudinal associations for efficient prognosis of AD and PD.

Keywords: Alzheimer Disease; Parkinson Disease; Mediterranean Diet; neurodegenerative diseases

Author Contributions: M.B. and V.M. designed the research; S.S. conducted the systematic literature search, performed the quality assessment and the data extraction; S.S. and M.B. reviewed the study selection; S.S. and M.B. wrote the manuscript; A.G., G.d.G., L.I., M.B.D. and V.M. critically reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

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Effects of a Dietary Intervention with Lacto-Ovo Vegetarian and Mediterranean Diets on Apolipoproteins, Lipid Profile and Cardiovascular Risk: Results from the CARDIVEG Study [†]

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Abstract: Background: Cardiovascular disease (CVD) remains the leading cause of death worldwide. Attention in recent years is turning toward the role that apolipoproteins might play as markers of CVD risk. However, to date, evidence regarding the effects of diet on apolipoproteins is still limited. Aim: To compare the effects of the Mediterranean diet (MD) and lacto-ovo vegetarian diet (VD) on anthropometric parameters, lipid profile, inflammatory profile and apolipoprotein levels, in subjects with low-to-moderate CVD risk. Methods: Fifty-two clinically healthy subjects (39 F; mean age: 49.1 ± 12.4 years), followed an MD and a VD for 3 months each. Demographics, risk factors, dietary and lifestyle habits were collected from each subject at the baseline. Anthropometric parameters and blood samples were obtained both at the beginning and at the end of the MD and VD periods. Results: Both MD and VD resulted in significant reductions in body weight, BMI and fat mass. VD led to a significant reduction in LDL (−5%; $p = 0.038$), while MD led to a significant reduction in plasma triglycerides (−9%; $p = 0.018$). Both diets led to a reduction in most of the inflammatory parameters, but MD was more effective in reducing IL-10 (−37.2%; $p = 0.009$) and IL-17 (−49.1%; $p = 0.002$). As for apolipoproteins, a statistically significant change was observed only for Apo C1 after VD (+24.4%; $p = 0.020$). MD led to a statistically significant negative correlation between Apo C3 and carbohydrates ($R = -0.29$; $p = 0.039$), whereas VD led to a statistically significant negative correlation between Apo D and saturated fats ($R = -0.38$; $p = 0.006$). In addition, a statistically significant positive correlation emerged after MD between change in plasma triglycerides and change in Apo C1 ($R = 0.32$; $p = 0.020$) and Apo D ($R = 0.30$; $p = 0.031$). On the other hand, after VD, a significant positive correlation emerged between change in HDL and Apo D ($R = 0.33$; $p = 0.017$). Subgroup analysis revealed positive effects on apolipoprotein levels from both diets, especially in women, individuals with >50 years and those with <3 CVD risk factors. Conclusions: Both diets resulted in improved apolipoprotein levels, especially in certain population subgroups, while also demonstrating different associations with specific dietary nutrients.

Keywords: cardiovascular risk; apolipoproteins; Mediterranean diet; vegetarian diet

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Circulating NMR Metabolites in White and British Indian Vegetarians and Non-Vegetarians in the UK Biobank [†]

Tammy Y. N. Tong ^{1,*} , Julie A. Schmidt ², Timothy J. Key ¹ and Ruth C. Travis ¹



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Abstract: Background and objectives: Metabolomics is influenced by diet and may inform underlying mechanisms for diseases. We aimed to assess differences in circulating metabolites between people of different habitual dietary groups. Methods: The UK Biobank recruited 500,000 adults aged 40 to 69 years throughout the UK between 2006 and 2010. Plasma samples were collected from almost all participants at recruitment, and metabolomics assays (249 metabolites, 168 directly measured and 81 ratios) were performed using nuclear magnetic resonance (NMR) metabolic profiling in a randomly selected subset of 120,000 participants. Participants were asked to report their ethnicity and consumption of red and processed meat, poultry, fish, dairy and eggs. Based on this information, we defined six diet groups among the White British participants (42,963 regular meat eaters, 44,170 low meat eaters, 1051 poultry eaters, 2290 fish eaters, 1521 vegetarians and 102 vegans) and two diet groups among the British Indians (725 meat eaters and 250 vegetarians). We compared adjusted geometric mean levels of the metabolites by diet group. Results: Significant differences in the levels of many plasma metabolites were observed by diet group, with the biggest differences overall for fatty acids. Compared with regular meat eaters, low meat, poultry and fish eaters all had higher omega-3 and docosahexaenoic acid concentrations, while vegetarians and vegans had substantially lower concentrations of these fatty acids and their ratios to total fatty acids. Vegetarians and vegans had significantly higher ratios of omega-6 to both omega-3 and total fatty acids, as well as higher percentages of monounsaturated fatty acids and linoleic acid to total fatty acids. Of the amino acids, vegetarians and vegans had notably higher concentrations of glycine, but lower concentrations of total and individual branched-chain amino acids compared with regular meat eaters. Higher concentrations of citrate but lower concentrations of creatinine in vegetarians and vegans, higher acetate in vegans, as well as differences in many lipid fractions by diet group were also observed. The observed differences were similar for the White British and the British Indian participants. Discussion: The markedly different plasma metabolic profiles between people of different diet groups may impact on their long-term health.

Keywords: vegetarians; vegans; metabolomics

Author Contributions: Conceptualization, T.Y.N.T., T.J.K. and R.C.T.; methodology, T.Y.N.T., J.A.S., T.J.K. and R.C.T.; formal analysis, T.Y.N.T.; investigation, T.Y.N.T.; data curation, T.Y.N.T.; writing—original draft preparation, T.Y.N.T.; writing—review and editing, T.Y.N.T., J.A.S., T.J.K. and R.C.T.; funding acquisition, T.Y.N.T., T.J.K. and R.C.T. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: This research has been conducted using UK Biobank Resource under application 67506. Bona fide researchers can apply to use the UK Biobank data set by registering and applying at <http://ukbiobank.ac.uk/register-apply/>.

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The Effects of 25-Hydroxyvitamin D3 and Ascorbate on Extracellular Cytokine Concentrations in THP-1 Monocytes and THP-1 Derived Macrophages [†]

Mark Dewane ^{*}, Caroline Childs , Elizabeth Miles and Philip Calder



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Abstract: Vitamins C and D are known to have

immunomodulatory effects. Current recommendations state that plasma 25-hydroxyvitamin D3 should be maintained above 50 nmol/L, although concentrations of 100 nmol/L can enhance health benefits. Concentrations below 25 and 12.5 nmol/L are considered insufficient and deficient, respectively. The typical plasma ascorbate concentration is 50 µmol/L. Vitamin C supplementation can increase plasma concentration to 100–150 µmol/L. Vitamin C insufficiency and deficiency occur at 25 µmol/L and <10 µmol/L, respectively. This study investigates cytokine production by THP-1 monocytes and macrophages, following vitamin C and D treatment at concentrations representing deficiency, insufficiency, sufficiency and following supplementation. Macrophages were differentiated from THP-1 monocytes using PMA. THP-1 cells (monocytes or macrophages) were pre-treated with ascorbate or 25-hydroxyvitamin D3 for 24 h at the aforementioned concentrations, then challenged with lipopolysaccharide for 6 and 24 h. Extracellular concentrations of IL-1β, IL-6, IL-10 and TNF-α were measured using Luminex assays. In THP-1 monocytes, 25-hydroxyvitamin D3 and ascorbate, at concentrations representing sufficiency and supplementation, decreased TNF-α, IL-1β and IL-6 at 6 and 24 h. Ascorbate at concentrations of >50 µmol/L also increased IL-10 at both time points. At supplemented concentrations, 25-hydroxyvitamin D3 and ascorbate lowered the TNF-α/IL-10 ratio from 39:1 to 31:1 and 17:1, respectively, at 6 h. At 24 h, TNF-α/IL-10 was lowered from 88:1 to 31:1, following 150 µmol/L ascorbate treatment, and from 185:1 to 108:1 following 100 nmol/L 25-hydroxyvitamin D3 treatment. In THP-1 macrophages, pro-inflammatory cytokines were unaffected by 25-hydroxyvitamin D3 at 6 h. However, IL-10 concentration increased at concentrations > 50 nmol/L. At 24 h, the inflammatory cytokines decreased as the 25-hydroxyvitamin D3 concentration increased. 25-hydroxyvitamin D3 (100 nmol/L) reduced the TNF-α/IL-10 ratio from 88:1 to 64:1 at 6 h and from 105:1 to 35:1 at 24 h. Ascorbate, at concentrations representing sufficiency and supplementation, decreased the inflammatory cytokines at 6 and 24 h. Ascorbate at 150 µmol/L decreased TNF-α/IL-10 from 116:1 to 35:1 at 6 h and from 102:1 to 21:1 at 24 h. These data demonstrate that both 25-hydroxyvitamin D3 and ascorbate decrease the inflammatory burden in THP-1 monocytes and THP-1 derived macrophages. Future work will investigate vitamin interactions and underlying mechanisms.

Keywords: monocyte; macrophage; inflammation; cytokine; vitamin D; vitamin C; ascorbate

Author Contributions: Conceptualization, M.D. and P.C.; methodology, M.D.; formal analysis, M.D.; investigation, M.D.; writing—original draft preparation, M.D.; writing—review and editing, C.C., E.M. and P.C.; supervision, C.C., E.M. and P.C.; project administration, P.C.; funding acquisition, P.C. All authors have read and agreed to the published version of the manuscript.

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Early Changes in Observed Eating Behaviours and Suboptimal Weight Loss in Gastric Bypass Patients: Preliminary Findings [†]

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Keywords: gastric bypass; suboptimal weight loss; energy intake; eating behaviours



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Bariatric surgery is the most effective long-term treatment for severe obesity [1], however despite excellent results being obtained at the group level, the response and durability of weight loss after surgery is heterogeneous and a proportion of patients may experience suboptimal weight loss (SWL) [2]. The mechanisms underlying SWL are poorly understood but may be linked to eating behaviours [2].

The aim of this work was to identify if early changes in energy intake (EI) and eating behaviours at 1-year are associated with long-term weight outcomes 5-years postsurgery. Twenty-two patients, after gastric bypass (gender: 18 F, 82.0%, 46.2 ± 1.6kg/m², 46.1 ± 2.6 years), attended residential research appointments pre-surgery (−1 month) and at 12- and 60-months post-surgery. At each time point, EI (MJ) and eating behaviours (dietary energy density, eating speed, and number, size and duration of eating occasions) were determined over a 24-h period using the covert weighing of food and validated via closed circuit television. Body composition was measured using dual-energy X-ray absorptiometry and the percentage of total weight loss (%TWL) used to distinguish between patients who had suboptimal (<15% TWL) and patients with optimal weight loss (15–25%, or, >25% TWL) at 5 years post-surgery.

Briefly, 5 patients experienced SWL (−9.2 ± 1.8%), while 7 patients experienced 15–25% TWL (−21.9 ± 1.4%), and 10 patients experienced >25% TWL (−35.0 ± 1.8%). There were no differences in EI or dietary energy density between the three groups at baseline, or percentage changes at 1-year post-surgery (ANOVA; $p > 0.54$ and $p > 0.48$, respectively). Those experiencing SWL did not change their eating speed post-surgery, whilst those with optimal weight loss (>25%) reduced their eating speed (+7.2 ± 0.53, +133.8 ± 0.53%, −18.9 ± 21.2%, for SWL [<15%], 15–25% and >25% TWL; $p = 0.01$). Those with optimal weight loss also decreased their EI per eating occasion at 1 year (−53.2 ± 2.8%, +88.9 ± 105.0%, −57.8 ± 6.9%, for SWL [<15%], 15–25% and >25% for TWL; $p = 0.01$). These findings indicate that targeting interventions to the stratum of patients



with such eating behaviours could enhance weight loss. Further work is required to verify findings and identify other modifiable eating behaviours in those most at risk of SWL.

Author Contributions: Conceptualization, R.K.P., M.B.E.L., C.L.R. and A.S.; Formal analysis, H.S.; investigation, H.S., A.M., J.S., C.L.R., A.S., M.A.K., C.I.R.G., M.B.E.L. and R.K.P.; writing—original draft preparation, H.S.; writing—review and editing, H.S., A.M., J.S., C.L.R., A.S., M.A.K., C.I.R.G. and R.K.P.; visualization, A.M., J.S., C.L.R., A.S., M.A.K., C.I.R.G., M.B.E.L., R.K.P., Z.B., D.D.K. and D.J.P.; supervision, A.M., J.S., C.L.R., M.A.K., C.I.R.G. and R.K.P.; funding acquisition, R.K.P., C.L.R. and A.S. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data described in the abstract will be made available upon request pending application and approval.

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Abstract

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The Effects of Low- vs. High-Glycemic Index Mediterranean-Style Eating Patterns on Subjective Well-Being and Sleep in Adults at Risk for Type 2 Diabetes: The MEDGICarb-Intervention Trial [†]

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Abstract: Background and objectives: Limited evidence exists regarding the influence of glycemic index (GI) in the context of a healthy diet on self-reported health status and sleep. We therefore aimed to investigate the effects of a low- vs. high-GI Mediterranean-style healthy eating pattern (MED-HEP) on subjective well-being and sleep, and whether measures of well-being and sleep were related to glycemia. Methods: The MedGICarb-intervention trial is a 12-week randomized, controlled, parallel multi-center trial (Italy, Sweden and USA). During the intervention, participants consumed an eu-energetic diet profiled as a MED-HEP with either high or low GI. Well-being and sleep were measured by the Medical Outcomes Study 36-Item Short Form Health Survey Version 2 (SF-36v2), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) at baseline and after the 12-week intervention. Similarly, postprandial glucose was measured from oral glucose tolerance tests, and indices of glycemic variability were calculated from 24 h continuous glucose monitoring. Results: 161 adults with ≥ 2 features of the metabolic syndrome completed the intervention (53%



females, mean age 56 ± 10 y, mean BMI 31 ± 3 kg/m²). Low- vs. high-GI MED-HEP resulted in differential changes between the groups in domains of well-being, driven mostly by improvements in the low-GI group, of which role physical (5.6 AU vs. -2.5 AU, $p = 0.022$) and vitality (6.9 AU vs. -0.3 AU, $p = 0.008$) were significant (ANOVA with group, site and sex as fixed factors and age and BMI as covariates). There was no significant difference between the diets for aggregated physical or mental components, or for the other domains of well-being

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(physical functioning, bodily pain, general health, social functioning, role emotional, mental health) or for sleep quality (PSQI) or daytime sleepiness (ESS). The aggregated physical and mental component, as well as some domains of well-being and sleep quality, were correlated with glycemic measures at baseline (Spearman correlation). Discussion: Low compared to high GI in the context of a MED-HEP resulted in improvements in domains of subjective well-being. No major differences were seen between the groups for indexes of sleep.

Keywords: glycemic index; Mediterranean diet; well-being; sleep; glycemic control

Author Contributions: Conceptualization, R.E.B., R.L., G.R. and W.W.C.; methodology, R.E.B., W.W.C., R.L. and G.R.; investigation, R.E.B., R.G. and M.V.; resources, W.W.C., R.L. and G.R.; data curation, A.H. and A.H.; writing—original draft preparation, A.H.; writing—review and editing, R.E.B., R.G., M.V., W.W.C., G.R. and R.L.; supervision, W.W.C., G.R. and R.L.; project administration, R.E.B., R.G. and M.V.; funding acquisition, G.R., R.L. and W.W.C. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the institutional review board of Federico II University and Purdue University and by the Regional Ethical Review Board, Gothenburg, Sweden. The trial is registered in the public trial database Clinicaltrials.gov as NCT03410719.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Eating Habits and Sleep Quality in Patients with Type 1 Diabetes on Advanced Technologies [†]



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Abstract: Background and objectives: Sleep disorders are bidirectionally linked with eating behaviors and glucose metabolism, and this could be clinically relevant in type 1 diabetes (T1D). We investigated the relationship between dietary habits and sleep quality in T1D. Methods: According to a cross-sectional design, T1D patients, 60 men and 60 women, aged 19–79, using continuous glucose monitoring (CGM) filled-in a 7-day food diary and completed the European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire on dietary habits and the Pittsburgh Sleep Quality Index (PSQI) questionnaire on sleep quality. Blood glucose values over 6 h after dinner were registered for one week. Differences in dietary habits and blood glucose were compared between the participants with good/bad quality, long/short duration, and long/short onset latency of sleep. Results: Bad sleepers ($n = 84$) were twice as prevalent as good sleepers ($n = 36$) and had significantly higher intake of fat than good sleepers, in particular at dinner time (30.7 ± 10.7 vs. 24.0 ± 10.5 g, $p = 0.004$). Short sleepers had significantly higher usual intake (g/1000 kcal) of coffee and tea (88.7 ± 70.9 vs. 62.0 ± 35.6), alcoholic beverages (46.6 ± 50.4 vs. 28.9 ± 31.5), and carbonated soft beverages (21.0 ± 37.5 vs. 9.3 ± 17.2) ($p < 0.05$ for all). Compared with the short sleep onset latency participants, the long sleep onset latency participants had significantly higher intake of fat at dinner time (41.8 ± 7.4 vs. $38.1 \pm 9.1\%$ total energy, $p = 0.029$). No differences in post-dinner blood glucose were detected between the participants with bad or good sleep quality. Discussion: Sleep disruption is common in T1D and is associated with unhealthy dietary choices, especially at dinner time, independently of post-dinner blood glucose control.

Keywords: sleep quality; dietary habits; type 1 diabetes; sleep latency onset; postprandial glycemia

Author Contributions: Conceptualization, L.B. and A.C.; validation, M.V., G.C., G.D.P. and L.B.; formal analysis, A.C., M.V., G.C. and G.D.P.; investigation, A.C. and G.C.; data curation, G.S. and A.C.; writing—original draft preparation, L.B., A.C., M.V., G.C. and G.D.P.; writing—review and editing A.A.R. and L.B.; supervision, A.A.R. and L.B.; funding acquisition, L.B. All authors have read and agreed to the published version of the manuscript.

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An Observational Study of the Effect of Diet and Micronutrient Intake on the Association between Depression and Gastrointestinal Symptoms via an Online Survey Tool [†]

Fahim Syed ^{1,*}, Deili Sinimeri ², Caroline E. Childs ¹ and Dennis Golm ²



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Abstract: Background and objectives: Depression is a low mood-based disorder that affects approximately one in six people in the UK. Analyses of the gut in depressed individuals have demonstrated dysbiosis in the normal gut microbial composition. These imbalances have been associated with gut symptoms such as abdominal pain and nausea. This study aims to investigate the relationships between self-reported depression, gastro-intestinal (GI) symptoms and dietary intake. Methods: Participants with self-reported depression and healthy controls were recruited via Prolific. Participants were asked to complete a web-based online survey tool (Qualtrics), which included questions on diet, gut health and mental health. Estimated micronutrient intakes from reported fruit and vegetable intakes (FAVI) were calculated using dietary analysis software (myFood24). Results: In total, 496 adults consented to participate ($n = 249$ with self-reported lifetime diagnosis of depression, $n = 247$ healthy controls). There was a significant positive correlation between the GI symptom score and the depression score ($r = 0.506$, $p < 0.001$) which included reported measures of nausea ($r = 0.359$) and pain ($r = 0.419$). FAVI and omega-3 intakes were inversely related to GI symptoms ($p = 0.010$, $p < 0.001$, respectively) and depression scores ($p < 0.05$) and significant mediators of the association between GI symptoms and depression (effect size -0.006 , -0.025 respectively). Those with depression were found to have significantly lower intakes of vitamin C, folate, vitamin E and magnesium ($p < 0.05$), though analysis did not identify any significant mediation effects of micronutrient intake on the relationship between GI symptoms and depression scores. Discussion: Dietary intake has a significant mediation effect on the relationship between GI symptoms and depression. Participants in the depression group consumed significantly lower intakes of some important micronutrients found in FAVI, which suggests that depression and gut symptoms could influence food choices. Further research will be required to identify whether these observations correspond to the changes in the microbiome that have been associated with depression.

Keywords: depression; gut; fruit and vegetables; omega-3; probiotic

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The Role of Nutritional Factors in Cognitive Health in Ageing: Shedding New Light through Systematic Review with Meta-Analysis of Intervention Studies [†]

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Abstract: Background: The global population is ageing, with predictions that 150 million people will be living with dementia by 2050. Cognitive dysfunction and dementia have significant adverse impacts on quality of life in older adults. Therefore, the identification of modifiable risk factors is a major public health priority. Evidence suggests that certain dietary patterns and/or specific nutrients can contribute to reducing the risk of dementia; however, the evidence is inconsistent. Objectives: The aim of this systematic review with meta-analysis was to investigate the effect of dietary patterns and specific nutrients on cognitive function in older adults. Methods: The bibliographic databases MEDLINE, EMBASE and PsycINFO were used to identify relevant studies. Inclusion criteria included the following: randomised controlled trials (RCT) with specific nutrients or dietary intervention with control groups; duration ≥ 1 y; and adults ≥ 50 years. Meta-analyses were performed to calculate standardised mean differences (SMD) for global cognition and specific cognitive domains such as memory. Quality of evidence was evaluated using the GRADE (grading of recommendations, assessment, development, and evaluations) assessment framework. A sensitivity analysis was conducted to assess the impact of studies with a high-risk of bias. Results: A total of 23 studies were identified for inclusion in meta-analyses. Results showed that B-vitamin interventions

≥ 1 y had a significant beneficial effect on memory (SMD 0.09, 95% CI, 0.02 to 0.16; 13 studies; 7330 participants; moderate certainty); removing the B-vitamin studies ($n = 3$) at high-risk of bias did not change the overall result. RCTs of vitamin D supplementation improved cognitive function scores (SMD 0.88, 95% CI, 0.08 to 1.67; 4 studies; 4593 participants; very low certainty). No significant cognitive benefits were detected in response to omega-3 supplements; however, the analysis for this outcome was limited by far fewer studies. Discussion: B-vitamins may have specific benefits for the ageing brain. Enhancing the status of these nutrients could contribute to improved cognitive health; however, additional RCTs should target at-risk individuals with sub optimal B-vitamin status.

Keywords: ageing; cognitive function; dementia; dietary patterns; nutrients



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Meat-Based Diet Significantly Affects Risk Parameters for Colorectal Cancer: The MeaTlc Dietary Intervention Study [†]

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Abstract: Background: Colorectal cancer (CRC) is the most commonly diagnosed cancer in Europe and the second most common cause of cancer death. The aim of the MeaTlc study was to determine the impact of three diets associated with different risks of CRC (a meat diet (MBD: high risk), a meat diet with alpha-tocopherol supplementation (MBD-T: medium risk), and a pesco-vegetarian diet (PVD: low risk)) on CRC risk markers and fecal microbiota. Methods: A controlled, randomized, open-label, parallel-group, 12-week dietary intervention was conducted on 113 participants aged 18–50 years. The primary outcome was a change in fecal water (FW) genotoxicity. Secondary outcomes were changes in FW cytotoxicity, bile acids, fecal microbiota, and metabolomic profiles. Results: A total of 103 participants (91%) completed the study. After adjustment for possible confounding factors, a significant increase ($p < 0.05$) in FW genotoxicity (+43%) was observed only in the MBD group. Regarding FW cytotoxicity, a decrease in cell viability (−7%, $p = 0.054$) was observed after MBD, while no changes occurred for the other diets. Bile acid analysis showed an increase in total bile acids during MBD-T (+35%) and a decrease during PVD (−2.3%). Upon correlating changes in bile acids with FW genotoxicity and cytotoxicity, a moderate correlation ($R = 0.66$; $p < 0.0001$) emerged between changes in total bile acids and changes in FW cytotoxicity. A linear discriminant analysis (LDA) of changes in the gut microbiota revealed no clustering by diet, while metabolomic analysis showed a clear clustering of changes in metabolites. A random forest regression model identified 2-hydroxybutyric acid and cholic acids among the metabolites most correlated with FW genotoxicity ($R^2 = 0.84$ for the model). Conclusion: These results indicate that MBD can lead to a worsening of CRC markers in a relatively short time. Our findings also suggest that intervention diets had a greater impact on the metabolism of the gut microbiota, and thus, its metabolites, than on its taxonomic composition. A correlation between some metabolites and FW genotoxicity was also found.

Keywords: meat-based diet; colorectal cancer; microbiota

Author Contributions: Conceptualization, C.D.F., G.C. and F.S.; methodology, M.D. and F.S.; formal analysis, M.D. and S.Ö.; investigation, M.D., G.P., S.L., L.G., S.R. and F.S.; writing—original draft preparation, M.D.; writing—review and editing, C.D.F., L.G., G.C. and F.S.; supervision, C.D.F., L.G., G.C., J.B. and F.S.; funding acquisition, C.D.F., L.G., J.B., G.C. and F.S. All authors have read and agreed to the published version of the manuscript.

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Prognostic Role of Polyunsaturated Fatty Acids in the Adipose Tissue of Colorectal Cancer Patients [†]

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Abstract: Background and objectives: Nutritional intake and dysregulation of fatty acid metabolism play a role in the progression of various tumours. The consumption of different fatty acids is difficult to assess accurately by dietary questionnaires. Biomarkers allow objective assessments of intake, storage, and bioavailability. We studied the association between the polyunsaturated fatty acid (PUFA) composition of abdominal subcutaneous adipose tissue (a good indicator of dietary intake over 2–3 years) and all-cause mortality. Methods: In this multicentre AGARIC study, including 203 patients with colorectal cancer (CRC) undergoing curative surgery, samples were harvested from subcutaneous adipose tissue, which were analysed for PUFA composition. Cox proportional hazards models were used to estimate associations between PUFA levels and mortality. Results: After a median follow-up of 45 months, 76 patients died. These patients were more often men (72.4% vs. 57.5%, $p = 0.04$), diabetic (32.9% vs. 13.4%, $p = 0.001$), older (median: 74.5 vs. 66.6 years, $p < 0.001$), and with high alcohol consumption (47.4% vs. 30.7%, $p = 0.005$) compared to survivors. An increased risk of death was observed with higher levels of eicosadienoic acid (hazard ratio tertile3 vs tertile1 (HRT3vsT1) = 2.12; 95% confidence interval (CI) = 1.01–4.42; p -trend = 0.04), adrenic acid (HRT3vsT1 = 3.52; 95% CI = 1.51–8.17; p -trend = 0.005), and 22:5 n-6 (HRT3vsT1 = 3.50; 95% CI = 1.56–7.87; p -trend = 0.002). Conversely, the risk of death seemed to be lower when higher concentrations of γ -linolenic acid (HRT3vsT1 = 0.52; 95% CI = 0.27–0.99; p -trend = 0.04) and the essential fatty acid α -linolenic acid (HRT3vsT1 = 0.47; 95% CI = 0.24–0.93; p -trend = 0.03) were observed. The estimated δ -6-desaturase & elongase 5 enzyme activity were found to be positively associated with all-cause mortality (HRT3vsT1 = 2.25; 95% CI = 1.03–4.90; p -trend = 0.04). Discussion: The risk of death in CRC patients was increased in those with higher concentrations of certain n-6 PUFAs and lower concentrations of α -linolenic acid in their subcutaneous adipose tissue. These results reflect both dietary habits and altered fatty acid metabolism. Nevertheless, our exploratory results need to be confirmed in larger studies with further exploration of the mechanisms involved. The AGARIC study group: Scherrer Marie-Lorraine (Regional Hospital Centre Metz Thionville), Ayav Ahmet (University hospital of Nancy), Ortega-Deballon Pablo, (University hospital of Dijon), Lakkis Zaher (University hospital of Besançon), Liu David (University hospital Hautepierre of Strasbourg), and Deguelte Sophie (University hospital of Reims).



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Keywords: colorectal cancer; polyunsaturated fatty acids; adipose tissue; mortality; prognosis

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Olive Oil Consumption Is Associated with Lower Cancer Mortality among Italian Adults: Prospective Results from the Moli-Sani Study and Analysis of Potential Biological Mechanisms [†]

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Keywords: olive oil; Mediterranean diet; cancer mortality; common soil

Background and Objectives: Olive oil is a key component of a traditional Mediterranean Diet and its cardiovascular health benefits have been well documented in large cohorts worldwide. However, the relationship of olive oil with cancer mortality is less robust, and it remains unclear whether the health advantages of olive oil may be accounted for by specific biological mechanisms. We therefore sought to investigate the relationship between olive oil consumption with cancer mortality in an Italian general population, and to examine specific biological pathways common to major chronic diseases as possibly underlying these associations. **Methods:** Longitudinal analysis on 22,895 men and women (mean age 55.4 ± 11.7 y) from the Moli-sani Study (enrolment 2005–2010) followed up for 12.2 years. Dietary data were collected using a semi-quantitative food frequency questionnaire, and olive oil consumption was standardized to a 10 g tablespoon (tbsp) size. Cox regression models were used to estimate hazard ratios (HRs) and 95% confidence intervals (95% CIs). **Results:** Compared with individuals who rarely consumed olive oil (≤1.5 tbsp/d), participants who had the highest consumption (>3 tbsp/d) reported 28% lower rates of cancer death (HR = 0.72; 95% CI: 0.54–0.94); a linear dose–response relationship was observed (*p* value for overall association = 0.030; *p* for non-linearity = 0.47). Higher intake of olive oil was also linked to an 18% reduced rate of mortality from any cause (HR = 0.82; 95% CI: 0.70–0.97), while the association with CVD mortality was not unequivocal (HR = 0.80; 95% CI: 0.60–1.06). Among the known risk factors analyzed, lower levels of blood pressure and resting heart rate associated with consumption of olive oil accounted for 14.5% and 8.1% of its inverse relationship with all-cause and cancer mortality, respectively. **Discussion:** Higher olive oil consumption was associated with higher survival that was largely driven by a reduction in cancer mortality, independent of overall diet quality. Known risk factors for major chronic diseases mediate such associations only in part, suggesting that other biological pathways are potentially involved in this relationship.

Author Contributions: Conceptualization, E.R. and M.B.; methodology, E.R. and A.D.C.; validation, S.C.; formal analysis, E.R.; data curation, S.C. and E.R.; writing—original draft preparation, E.R.; writing—review and editing, M.B.D., S.E., M.B. and L.I.; supervision, M.B. and L.I. All authors have read and agreed to the published version of the manuscript.

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Dose–Response Relationships of Five Dietary Patterns with the Risk of Cancer: Findings from the UK Biobank Study [†]

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Dose–Response Relationships of Five Dietary Patterns with the Risk of Cancer: Findings from the UK Biobank Study. *Proceedings* **2023**, *91*, 41. <https://doi.org/10.3390/proceedings2023091041>

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Abstract: Diet is an important risk factor for cancer. Several approaches for assessing the nutritional quality of diets have been developed and are associated with cancer risk. However, the evidence is limited for some dietary patterns. This study investigated the associations between five dietary patterns and incident all-cause cancer. This study included 159,631 adults from the UK Biobank cohort who were free from cancer at baseline. All-cause cancer was derived from cancer registry linkage. Dietary intake was evaluated according to five dietary pattern scores: the energy-adjusted Dietary Inflammatory Index (E-DII), the Recommended Food Score (RFS), the Healthy Diet Indicator (HDI), the Mediterranean Diet Score (MDS), and the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND). All dietary scores were categorised into tertiles, and the unhealthiest tertile for each score was used as the reference group. Cox regression was performed to investigate associations between each of the five dietary scores and all-cause cancer incidence, adjusting for sociodemographic (age, sex, ethnicity, deprivation, and income) and lifestyle (smoking status, total sedentary time, and total physical activity) factors, adiposity (BMI), and multimorbidity. After a median follow-up of 7.8 (IQR: 7.3; 10.6) years, 11,978 adults developed cancer. The RFS (HR 0.96 [95% CI 0.94; 0.98]), HDI (HR 0.96 [95% CI 0.94; 0.99]), and E-DII (HR 0.97 [95% CI 0.95; 0.99]) were inversely associated with the risk of all-cause cancer. Compared with the lowest tertile, the risk of all-cause cancer was lower for adults in the healthiest tertile for the RFS (HR 0.92 [95% CI 0.88; 0.96]), HDI (HR 0.93 [95% CI 0.89; 0.97]), and E-DII (HR 0.94 [95% CI 0.90; 0.99]). No associations were found for the MDS and MIND. A lower risk of all-cause cancer was observed with greater adherence to three of the five investigated dietary patterns (RFS, HDI, and E-DII) independent of adiposity and sociodemographic and lifestyle factors.

Keywords: cancer; diet; cohort; dietary patterns

Author Contributions: Conceptualization, S.P.-S. and C.C.-M.; methodology, S.P.-S. and C.C.-M.; software C.C.-M., F.H. and J.P.; formal analysis, S.P.-S. and C.C.-M. investigation, C.C.-M., F.H. and J.P.; writing—original draft preparation, S.P.-S.; writing—review and editing, all authors; supervision, C.C.-M., F.H. and J.P. project administration, C.C.-M., F.H. and J.P. All authors have read and agreed to the published version of the manuscript.

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Effect of 15-Week n-3 Fatty Acid Supplementation on Inflammation and Iron Absorption in African Women Living with Overweight and Obesity [†]

Isabelle Herter-Aeberli ^{1,*}, Linda Malan ², Mary A. Uyoga ², Angeliqwe Lewies ³, Lizelle Zandberg ², Marius Smuts ² and Jeannine Baumgartner ⁴



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Abstract: Background and objectives: Obesity is a state of chronic low-grade inflammation, which may improve with n-3 long-chain polyunsaturated fatty acid (LCPUFA) treatment in populations with low n-3 LCPUFA status. Inflammation reduces iron bioavailability by increasing hepcidin concentrations, leading to iron sequestration in macrophages and reduced intestinal iron absorption. Therefore, the objective of this study was to investigate the effects of n-3 LCPUFA supplementation on inflammatory markers and fractional iron absorption in overweight and obese individuals with chronic low-grade inflammation and a low n-3 LCPUFA status. Methods: In a single group stable iron isotope study, overweight and obese women of African descent ($n = 33$) with a BMI ≥ 28 kg/m², C-reactive protein (CRP) between 2 and 20 mg/L, Hb ≥ 11 g/dL and n-3 index $< 6\%$ were supplemented with ~ 2 g DHA/EPA daily for 15 weeks. Inflammatory markers, hepcidin, iron status indices and erythrocyte total phospholipid fatty acid composition (% of total fatty acids) were measured at baseline and endpoint. Fractional iron absorption (%) was determined by measuring erythrocyte incorporation of isotopically labelled iron (⁵⁸Fe) at the baseline and endpoint. Sample analysis is ongoing and the results, including fractional iron absorption, for all participants will be available by the time of the conference. Results: Thirty women completed the study. Their mean BMI at baseline was 36.7 ± 8.08 kg/m², they had a mean n-3 index of $4.57 \pm 0.83\%$, and median (95% CI) fractional iron absorption (FIA) was 11.8% (7.1–20.1). The n-3 index increased to $6.59 \pm 0.82\%$ ($p < 0.001$) but there was no change in FIA (9.7% (5.1–15.8), $p = 0.962$). Inflammatory status at baseline was characterized by a median (IQR) CRP of 4.15 (1.50–7.90) mg/L and alpha-1-glycoprotein of 0.99 (0.76–1.11) g/L and there was no change at endpoint. Median serum ferritin was 28.1 (12.3–71.6) µg/L and soluble transferrin receptor was 5.9 (4.8–7.1) mg/L, resulting in body iron stores of 4.80 (0.85–6.92) mg/kg body weight. Discussion: The overweight and obese women in this study had a low n-3 index and high inflammatory status at baseline. Despite improvement of the n-3 index after 15-week supplementation, inflammatory markers and FIA did not improve at endpoint. To understand whether the improvement of the n-3 index was insufficient or the supplement dose too low requires further investigation.

Keywords: n-3 fatty acid supplementation; inflammation; obesity; iron absorption; DHA; EPA

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: After publication of the main results of the study data can be made available upon approval of a request.

Conflicts of Interest: The authors declare no conflict of interest.

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Young People's Health Interest, Nutrition Knowledge, and Views about Obesity[†]

Salma Abuznada*, Emilie Combet and Ada Garcia



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Abstract: Background: Obesity is prevalent in young people, yet

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limited research explores young people's views regarding nutrition, health, and obesity. Objectives: The aim of this study was to explore young people's views about obesity and factors mitigating this condition. Methods: An online cross-sectional survey was distributed to UK participants aged 12–19. The survey measured views about obesity and its management (Likert scale of 1–5, 14 questions), interest in health and nutrition (Likert scale of 1–5, 2 questions), and nutrition knowledge (scored as “low” or “high” based on a threshold of giving 3 out of 6 correct answers to multiple-choice questions about nutrient sources in diet). Self-reported weight, height, and sociodemographic data were collected. Independence between variables was explored using χ^2 tests. Results: Participants ($n = 317$, median age of 16, IQR15–18) were equally distributed between the two sexes (54% boys) and were mostly British (72%). Approximately one quarter (22%) had a BMI ≥ 30 kg/m² and most (61%) had a BMI < 25 kg/m². Participants had a high interest in health (median 4, IQR 4–5, 86% agreeing/strongly agreeing) and in the relationship between food, diet, and health (median 5, IQR 4–5, 83% agreeing/strongly agreeing). However, most participants (83%) had low nutrition knowledge. There was a relationship between interest in health (classified as interested/neutral/not interested) and sex ($p = 0.02$, 81% girls and 90% boys interested), but no relationship with BMI groups ($p = 0.5$). Over half (59%) agreed that obesity is a medical condition (median 4, IQR 3–4). There was a relationship between this agreement and sex ($p < 0.001$, 68% girls and 53% boys), but no relationship with BMI ($p = 0.9$) or nutrition knowledge ($p = 0.9$). Across the weight management options (including dieting, exercise, surgery, and medication), participants most likely agreed that combining diet and exercise is important to manage obesity (median 4, IQR 4–5, 77% agreeing/strongly agreeing). There was a relationship between this agreement and nutrition knowledge ($p = 0.04$, 75% among those with low knowledge and 90% among those with high knowledge), but no relationship with sex ($p = 0.08$) or BMI ($p = 0.9$). Discussion: In this sample representative of both sexes, obesity was generally recognised as a disease regardless of BMI or nutrition knowledge; however, sex played a role, with boys less likely to agree, despite their greater interest in health than girls. However, the sample's levels of interest in health (high) and nutrition knowledge (low) were homogenous, which limited further exploration. The influences of socioeconomic status, parental occupation, and family obesity experiences need further exploration.

Keywords: young people; obesity; views; nutrition; health

Author Contributions: Conceptualization, S.A. and E.C.; methodology, S.A., E.C. and A.G.; software, S.A.; validation, S.A., E.C. and A.G.; formal analysis, S.A.; investigation, S.A.; data curation, S.A. and E.C.; writing—original draft preparation, S.A.; writing—review and editing, S.A., E.C. and A.G.; supervision, E.C. and A.G.; project administration, S.A., E.C. and A.G.; funding acquisition, S.A. All authors have read and agreed to the published version of the manuscript.

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Effectiveness of Dietary Guidelines for Reducing Free Sugar Intakes: A Randomised Controlled Trial [†]

Lucy Boxall ^{1,*} , Katherine M. Appleton ¹ , Emily Arden-Close ¹  and Janet James ² 



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: National dietary guidelines aim to educate and assist the public by enhancing overall diet health and decreasing health risk. Despite the widespread use of food-based dietary guidelines, assessments into their effectiveness are lacking. **Methods:** Using a randomised controlled parallelgroup trial, 242 adults (18–65 years) consuming >5% total energy intake from free sugars (FS) were randomised to receive nutrient-based (N) (n = 61), nutrient- and food-based (NF) (n = 60), nutrient-, food- and food-substitution-based recommendations (NFS) (n = 63) or no recommendations regarding free sugar intake (control, n = 58). Effects were assessed for dietary and health outcomes, with our primary outcomes being the % of total energy intake from FS (%FS) and adherence at an endpoint of 12 weeks. Participants achieving a ≥ 2% reduction in %FS from baseline or <5% %FS intakes and those that did not, were classified as adherent or non-adherent, respectively. There were no significant differences between the groups in baseline variables, with 200 participants completing dietary outcomes at week 12. Data were analysed on an intention to treat basis. Multiple regression models significantly predicted endpoint %FS ($F(7, 234) = 8.86, p < 0.001$), $R^2 = 0.21$. Significant predictors were recommendations received ($B = -0.636, p = 0.029$), baseline %FS ($B = 0.377, p < 0.001$) and baseline bodyweight ($B = -0.04, p = 0.041$). There were no significant differences at baseline %FS (mean with standard error in parentheses); control with 10.36% (0.67), N with 10.15% (0.66), NF with 10.68% (0.62), and NFS with 10.19% (0.56). The mean %FS reduced in all intervention groups, with the reduction in N, NF, and NFS being 2.47%, 3.25%, and 3.08%, respectively, in comparison to no change in the control group (−1.18%). No significant differences were found between the three intervention groups at endpoint %FS. At endpoint, adherence counts were larger in all intervention groups, N with 39; NF with 39; and NFS with 37; than the control group with 23, the reverse was observed for non-adherence with 22, 21, 26, and 35, respectively. Our results show that providing participants with N, NF or NFS dietary guidelines reduced %FS for 12 weeks. Further analyses will investigate the time course of these effects, and effects on our other outcomes.

Keywords: food-based dietary guidelines; dietary intakes; sugars; taste profiles

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Development and Implementation of Food-Based Dietary Guidelines in the Slovak Republic [†]

Jana Babjakova ^{1,*} , Adela Penesova ² , Peter Minarik ^{2,3} , Daniela Minarikova ^{3,4} and Jozef Golian ⁵



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Abstract: Nutrition plays a fundamental role in preventing chronic non-communicable diseases and promoting overall health. In response to the absence of official dietary recommendations in the Slovak Republic, a collective of authors collaborated with state health institutions develop Food-based Dietary Guidelines (FBDGs) for adults, focusing on food groups and scientifically based information about nutrition concerning individual requirements, with consideration for the basic characteristics of the health status of the Slovak population. The FBDGs were submitted in 2021–2022, divided into two parts (general and special—Štandardný postup na výkon prevencie: “Odporúčania pre stravu a výživu u dospelých”, “Odporúčania pre stravovanie a výživu u dospelých—špeciálna časť”), and were approved by the Ministry of Health SR and integrated into standard procedures for implementing prevention, supported by a grant from the Human Resources operational program of the Ministry of Labour, Social Affairs, and Families (*Development of the new and innovative guidelines for prevention and their implementation into medical practice*). The FBDGs were methodologically prepared following the European Food Safety Authority’s (EFSA) recommendations, adapting European and non-European FBDGs to local Slovakia’s conditions. The proposal for Slovak FBDGs was the result of the consensus of the standard’s authors. The guidelines cover scientific information about various food groups, such as vegetables and fruits, starchy foods, protein-containing foods, and fats, deal with drinking regimens, and contain evidence about recommended food patterns, food hygiene, and food labelling. The recommendations emphasize the protective effects of a properly set lifestyle throughout an individual’s life, including the significance of regular and reasonably intense physical activity, stress management, proper sleeping characteristics, absence of abuses, and limiting a sedentary lifestyle. In 2023, the authors plan to prepare a third part for the recommendations as an educational publication with visual aids to enhance the food and nutritional literacy of the public. This effort aims to support individual and population health and prevent diseases in Slovakia. The guidelines will serve as a resource for health professionals, policymakers, institutions, and media, enabling the protection of health, preventive and nutritional policies and programs, and advice to improve the population’s health. By providing comprehensive guidelines, the FBDGs will contribute to reducing the occurrence and consequences of chronic non-communicable diseases in the Slovak Republic.

Keywords: dietary guidelines; nutrition; prevention; adults; Slovak Republic

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Keywords: dietary guidelines; nutrition; prevention; adults; Slovak Republic

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Negative Dietary Practices among 7-Year-Old Schoolchildren in Bulgaria †

Vesselka Duleva *, Ekaterina Chikova-Iscener, Lalka Rangelova and Plamen Dimitrov



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Abstract: Background and objectives: Maintaining a balanced diet and regular exercise is especially important for first graders. Poor nutrition compromises the quality of life, school attainment, and growth and sets suboptimal dietary habits later in life. The aim of the present study is to assess negative dietary practices among first graders in Bulgaria. Methods: A cross-sectional survey of a nationally representative sample of 3051 7-year-old students was conducted in 2019. The research was carried out in strict compliance with the protocol developed by the WHO (World Health Organization) as part of the WHO European Childhood Obesity Surveillance Initiative (COSI). As part of the study, a questionnaire was presented to the families of the first graders to assess the frequency of food consumption by the children. Results: A quarter (25.3%) of the students did not consume breakfast on a daily basis. The majority did not eat fresh fruits (62.9%) and vegetables every day, excluding potatoes (66.3%). Furthermore, 18% of the children consumed dairy products less than once a week or never. Additionally, 14.8% had fruit juice every day. One-fifth (19.7%) of the students drank soft drinks most of the days or every day of the week (>4 days/week). Many children never consumed or consumed less than once a week protein-rich foods like meat (8.9%), fish (62.3%), eggs (26.4%), and legumes (25.9%). Most days or every day of the week (>4 days/week), a quarter (24.2%) of the children had salty snacks like chips, and half of them (49.7%) had sweet snacks like candies and cakes. Discussion: The results of the present study clearly demonstrate a suboptimal dietary model for first graders in Bulgaria. Only one-third of the children consumed fresh fruits and vegetables daily. The frequency of intake of soft drinks and salty and sweet snacks is too high. The frequency of consumption of protein-rich foods like fish, eggs, and legumes is suboptimal. First graders should become a special target group for policymakers in Bulgaria.

Keywords: dietary practices; schoolchildren

Author Contributions: Conceptualization, V.D. and E.C.-I.; methodology, P.D.; software, E.C.-I.; validation, V.D., L.R. and P.D.; formal analysis, V.D.; investigation, E.C.-I.; resources, P.D.; data curation, L.R.; writing—original draft preparation, E.C.-I.; writing—review and editing, V.D., L.R. and P.D.; visualization, E.C.-I.; supervision, V.D.; project administration, V.D.; funding acquisition, V.D. All authors have read and agreed to the published version of the manuscript.

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Gender Differences in Adherence to Dietary Recommendations and Guidelines among Community-Dwelling Older Italian Adults [†]

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Abstract: Background and objectives: Adhering to healthy dietary guidelines plays an essential role in maintaining population health, but data on older people exploring the gender dimension are scarce. We aimed to investigate the gender differences in adherence to dietary recommendations among an Italian population of older men and women. Methods: We included participants aged ≥ 65 years from the cross-sectional NutBrain study, recruited in 2019–2023 in northern Italy. Dietary habits were assessed using a 102–semi-quantitative food frequency questionnaire. Adherence to recommendations was allocated for the intake of 23 food groups as described in the Italian Healthy Eating Guidelines-CREA. Variables were dichotomized as 0 = no adherence and 1 = adherence. The ‘Italian Dietary Recommendations Adherence Score (IDRAS)’ was calculated as an indicator of overall adherence to the dietary guidelines, by summing up each food group and then dividing them into tertiles. We compared the adherence to the recommendations and the IDRAS between men and women using the Chi-squared test. Results: A total of 802 participants were analysed (mean age 73.4 years \pm 6.2 SD, 59.2% women, 60.3% at least high education). Consumption of legumes (67.5%), fish (51.4%), bread (66.7%), milk and yoghurt (71.8%), fruit and vegetables (63.0%), and water (56.7%) was significantly lower than recommended values in the total sample. In contrast, consumption of cheese (54.1%), animal fats (54.0%), sweets and snacks (90.9%), red (54.0%) and processed meat (84.2%), and bakery products (85.9%) exceeded the recommendations. Women were more likely than men to meet the recommendations for non-alcoholic (70.5% vs. 57.8%) and alcoholic beverages (81.1% vs. 51.4%), red (32.8% vs. 26.3%) and processed meat (18.3% vs. 12.2%), potatoes (65.3% vs. 57.8%), and sugars (70.5% vs. 62.7%) and less likely to meet the recommendations for bread (26.3% vs 42.8%) and pasta (60.2% vs 64.5%). Overall, only 19,3% had high adherence to IDRAS (highest tertile); women had higher adherence than men (22.1% vs 15.3%). Discussion: Overall adherence to recommendations was low in the total sample, with women more likely than men to adhere to recommended dietary guidelines. Identifying gender differences in dietary intake and adherence to dietary recommendations is crucial for tailoring interventions and improving population nutrition strategies.

Keywords: dietary guidelines; gender differences; older adults; population health; cross-sectional study

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Estimating Usual Intakes Affecting the Macronutrient and Micronutrient Distribution among the Adolescent Population: A Study of Slovenian National Dietary Surveys SI.Menu 2017/18 [†]

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Abstract: Estimating the dietary intakes of certain populations is essential for making the right decisions on a national level in respect to nutrition, epidemiology, economic, environmental, and policy applications. The objective of this study is to determine the usual dietary intakes of macronutrients and micronutrients, considering how the population are individually affected by food and nutrient intakes. From the Central Register of Population, employing a two-stage stratified sampling procedure, a representative sample of adolescent participants was randomly selected, according to sex and place of residency. Two non-consecutive 24 h dietary recalls were collected using a web-based Open Platform for Clinical Nutrition (OPEN) software. Additionally, a food propensity questionnaire was used to collect information about a participant's frequency of food consumption. A total of 468 adolescent were included in the analyses: 10–12 years old (N = 194), 13–14 years old (N = 93), and 15–17 years old (N = 181). The analyses reveal dietary patterns that were different both between age groups and between genders. An overall lower variability in energy and fat intakes but a much higher variability for micronutrients was observed. Unbalanced usual dietary intakes were especially represented through high consumptions of foods that are high in sugar as well as fresh and processed meats, and low intakes of legumes and legume products, fruits and vegetables, while a higher variability was detected within dairy products. Determining the usual dietary intake using the Multiple Source Method provided wider intake distributions that allowed for more precise estimates for the prevalence of inadequate/excessive intakes for analyzed subpopulations. The overall results suggest a deviation from national dietary guidelines and a call for public health interventions in order to improve dietary patterns.

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Keywords: adolescents; dietary survey; 24-h recall; FPQ; usual dietary intake; multiple source method; macronutrients and micronutrients; food groups; Slovenia

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Genetic Risk Factors Modulate the Association between Physical Activity and Colorectal Cancer [†]

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Abstract: Physical activity (PA) is an established protective factor for colorectal cancer (CRC). However, the mechanisms underlying this relationship are less understood, and it is not known if the association is modified by genetic variants. To investigate this possibility, we conducted a genome-wide gene–PA interaction analysis. Using logistic regression and two-step and joint tests, we analyzed the interactions between common genetic variants across the genome and self-reported PA (categorized as active vs. inactive and as study- and sex-specific quartiles) in relation to CRC risk. PA had an overall protective effect on CRC, showing a 15% risk reduction among active vs. inactive participants (OR = 0.85; 95% CI = 0.81–0.90). The two-step GxE method identified an interaction between rs4779584, an intergenic variant located between the GREM1 and SCG5 genes, and PA for CRC risk ($p = 2.6 \times 10^{-8}$). Stratification by genotype at this locus showed a significant reduction in CRC risk by 20% in active vs. inactive participants with the CC genotype (OR = 0.80; 95% CI = 0.75–0.85), but no significant PA–CRC association was observed among CT or TT carriers. When PA was modeled as quartiles, the 1-d.f. GxE test identified that rs56906466, an intergenic variant near the KCNG1 gene, modified the association between PA and CRC ($p = 3.5 \times 10^{-8}$). Stratification at this locus showed that increase in PA (highest vs. lowest quartile) was associated with a lower CRC risk solely among TT carriers (OR = 0.77; 95% CI = 0.72–0.82). In summary, these results identified two genetic variants that modified the association between PA and CRC risk. One of them, related to GREM1 and SCG5, suggests that the bone morphogenetic protein-related, inflammatory and/or insulin signaling pathways may be associated with the protective influence of PA on colorectal carcinogenesis.

Keywords: physical activity; gene-environment interaction; colorectal cancer; GWAS

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Informed Consent Statement: All participants provided written informed consent at recruitment.

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Dietary Studies, Guidelines and Recommendations: Exploring Solutions to Folate Deficiency in the United Kingdom—Parsnips as a Case Study for Dietary Intervention [†]

Annabelle Somers ^{1,2,*} , Jenny Baverstock ¹, Philip Calder ³, Frances Gawthrop ⁴, Eleftheria Stavridou ² and Guy Poppy ¹

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Citation: Somers, A.; Baverstock, J.;



Abstract: One in six British teenagers is clinically deficient in folate. A growing body of evidence suggests that this could be negatively impacting their short- and long-term health, with folate deficiencies being linked with conditions such as depression, colorectal cancer, and Alzheimer's disease. To address this, there is a need to identify cost-effective, culturally appropriate, and sustainable interventions to improve folate intakes across the UK. This project explores how the root vegetable parsnip could be better utilised to help improve folate intake in vulnerable populations. To

understand the effects of genetics and growing conditions on nutritional quality, a microbiological assay has been used to explore the variation in folate content among different parsnip cultivars. This information will be combined with HPLC-based investigations of changes in folate content with storage, processing, and digestion to determine the difference between a parsnip in the field and a parsnip as it is purchased and consumed. In parallel, the adequacy of micronutrients provided in food system leverage points, such as school meals and hospital food, will be evaluated by analysis of recipes and meals. This will be compared to the UK government-recommended nutrient intake values to investigate whether sufficient micronutrients are being delivered in these settings. These research work packages will be combined to investigate whether the micronutrient content of meals provided in food system leverage points would be improved by the incorporation of more root vegetables, such as parsnips. Our research shows that the quantity and quality of folates in parsnip are affected by variation from farm to fork, including the variety grown, the length of storage, and how the parsnips are cooked before consumption. All of these factors should be taken into consideration when evaluating whether increased parsnip consumption could be implemented in food system leverage points like school meals to address folate deficiency in the UK. The same issues are likely to be the case for a range of other fruit and vegetables, and using the framework established with parsnip, the utility of other food-based interventions for addressing micronutrient insecurity in the UK can be assessed.

Keywords: food security; food systems; micronutrient deficiency; folate; *Pastinaca sativa*; parsnip

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Portion Size Recommendations in Food-Based Dietary Guidelines: A Global Review of the Methods [†]

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Abstract: Over the past decades, increased food intakes have contributed to rising obesity rates. This worldwide phenomenon partly results from the consumption of larger portion sizes. In this context, food-based dietary guidelines (FBDGs) have been described as an essential public health tool to guide populations toward achieving a healthier and balanced diet and reducing the risk of non-communicable diseases. Recent literature has underlined the wide variability in portion size recommendations as a future challenge to the derivation and success of FBDGs and has highlighted the need for common standard portions. This review aims to report the recommended portions of nine common food groups within existing FBDGs for the general adult population. The methods used to derive recommended portion sizes are also compared, including the type and scope of data used and the statistical approaches applied. The government-endorsed food-based dietary guidelines listed by the Food and Agriculture Organisation (FAO) were analysed, as well as their related scientific reports. Results from 99 FBDGs show that several countries ($n = 11$) promote the consumption of a variety of foods, without providing further reference quantities for daily food intake or portion size. Furthermore, some guidelines ($n = 13$) derive recommendations from local or national food consumption surveys, which may not necessarily align with appropriate or recommended intakes. When used, statistical methods for the derivation of recommended portions combine diverse criteria, including reported dietary habits (median food type/group intakes) and recommended levels of macronutrients and micronutrients of concern in the population. The inconsistencies in methodological approaches reflect uneven access to relevant dietary data, which in turn seems to drive the observed variability. This review informs the reader of the range and sources of variability in food group portion size recommendations across countries and constitutes a basis for the future elaboration of a global methodological framework to derive harmonised reference portions.

Keywords: food-based dietary guidelines; portion size

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Walnut Consumption Reduces Perceived Stress and Improves Mood States in a Sample of Young Adults: A Randomized Cross-Over Trial [†]

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Abstract: The relationship between psychological health and diet is bidirectional. As such, nutritional interventions can improve mood and wellbeing due to the complex interaction between nutrient intake and the gut–brain axis. Walnuts contain a number of potentially neuroactive compounds (e.g., tryptophan, serotonin, melatonin) that could have a potential effect on mood and wellbeing among the general population. Therefore, the present study sought to determine the effect of walnuts on perceived stress, mood states, and wellbeing. **Methodology:** A total of thirty young adults (aged 24.0 ± 4.2 years; 90% women) participated in an 18-week randomized crossover trial (NCT04799821). All the participants completed two randomized crossover protocols: intervention (daily consumption of 40 g of walnuts for 8 weeks) and control (refrain from walnuts or any other nuts for 8 weeks). After 2 weeks of washout, the two groups followed the intervention/control in reverse order. Baseline data were collected for perceived stress, mood states, and wellbeing. In addition, spot urine samples were collected at baseline for the determination of 5-hydroxy-3-indol acetic acid (urine serotonin metabolite). Data were collected once more at the end of the 8-week intervention and control periods. **Results:** After an 8-week intervention, daily walnut consumption significantly reduced perceived stress ($p = 0.008$) and improved certain mood states, such as anger–hostility and fatigue–inertia ($p = 0.026$ and $p = 0.010$, respectively). Furthermore, levels of serotonin’s metabolite were higher ($p = 0.035$) in the urinary samples of the intervention group, whilst no differences were shown between the baseline and control trials. Finally, daily walnut consumption did not affect wellbeing. **Discussion:** Our results show that daily walnut consumption has a significant impact on serotonin levels, and this could be associated with improved mood and stress states. However, more evidence is needed to explain the mechanisms underlying this association.

Keywords: walnuts; mood; food; stress; 5-hydroxy-3-indol acetic acid

Author Contributions: Conceptualization, M.F.Z.-R. and M.I.-P.; methodology, M.F.Z.-R., F.J.P.-C.; Data acquisition, M.F.Z.-R., A.I.-P. and M.I.-P.; data curation, M.F.Z.-R. and A.I.-P.; writing—original draft preparation, M.F.Z.-R.; writing—review and editing, M.I.-P.; project administration, M.I.-P.; funding acquisition, M.F.Z.-R. and M.I.-P. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data supporting the conclusions of this article will be made available by the authors on request.

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Walnut Consumption Improves Sleep Quality: A Randomized Controlled Trial [†]

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Abstract: Diet and sleep are two factors intrinsic to health which influence each other. For instance, diet may influence sleep via melatonin and its biosynthesis from tryptophan. Experimental data exist indicating that the provision of specific foods rich in tryptophan or melatonin can improve sleep quality. Walnuts are nutrient-dense foods that have a unique nutritional profile, including tryptophan and melatonin. However, clinical trials are needed to confirm the causal impact of walnuts on sleep and elucidate the underlying mechanisms. Therefore, our aim was to determine whether the daily consumption of walnuts could have a positive impact on sleep quality. **Methodology:** In this randomized cross-over trial (NCT04799821), 80 young adults (24.1 ± 3.9 years; 85.5% women) either ingested 40 g of walnuts daily (intervention) or refrained from eating walnuts or any other nuts (control) for 8 weeks, with a washout period of 2 weeks. The outcome variables included sleep quality, measured with actigraphy (duration, latency, wake after sleep onset (WASO), awakenings, and efficiency), daytime sleepiness (Epworth Sleepiness Scale), and the melatonin metabolite, 6-sulfatoxymelatonin (6-SMT), which was determined in urine samples collected (a) from 20:00 to 23:00 and (b) from 23:00 to 7:00. **Results:** The 8-week intervention with walnuts was significantly associated with an improvement in sleep quality ($p = 0.033$). Notably, the intervention was significantly associated with lower sleep latency ($p = 0.003$), higher sleep efficiency ($p = 0.022$), and less daytime sleepiness ($p = 0.004$). Furthermore, at the end of the intervention, the concentration of 6-sulfatoxymelatonin in urine samples from 20:00 to 23:00 was significantly higher ($p = 0.024$), whilst no differences were shown between the baseline and control conditions. **Discussion:** These data suggest that a daily serving of 40 g of walnuts provides an increase in melatonin which can be beneficial in improving sleep quality and in reducing daytime sleepiness in healthy young adults. However, more studies are needed to explain the mechanisms underlying this association.

Keywords: sleep quality; walnuts; 6-sulfatoxymelatonin

Author Contributions: Conceptualization, M.F.Z.-R. and M.I.-P.; methodology, M.F.Z.-R. and F.P.C.; Data acquisition, M.F.Z.-R., A.I.-P. and M.I.-P.; data curation, M.F.Z.-R., A.I.-P., M.D.-H. and T.C.; writing—original draft preparation, M.F.Z.-R.; writing—review and editing, M.I.-P.; project administration, M.I.-P.; funding acquisition, M.F.Z.-R. and M.I.-P. All authors have read and agreed to the published version of the manuscript.

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Do Statin Users Adhere to Dietary Recommendations for Cardiovascular Disease Prevention? [†]

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Abstract: Emerging evidence suggests that there is an interplay between the effects of diet and lipidlowering therapy in primary and secondary prevention of cardiovascular disease. All prevention strategies focus on modifiable risk factors, with special attention on dietary behavior. Lifestyle and dietary recommendations usually precede or accompany the prescription of statins. However, there is limited evidence of patients' adherence to dietary recommendations. The aim of this study was to investigate the dietary behavior of statin users, taking into account the intake of specific food groups. Data on clinical, demographic, health, and lifestyle factors were collected using a series of interviewer and self-completion questionnaires. Food group intake was calculated using 24 h dietary recalls for three non-consecutive days. The average daily intake for each subject was calculated as the mean of the three 24 h recalls. Food groups of interest included vegetables, fruits, grains, protein foods, and dairy products. Data were analyzed for 30 participants aged > 40 years. Patients with hypertension, diabetes, and current smokers represented 90%, 17%, and 27% of the study population, respectively. Almost 65% of the patients had a history of ischemic heart disease and were eligible for the secondary prevention of cardiovascular events. Mean daily dietary intake was 3.8 servings of protein, 4.1 servings of grains, 1.7 servings of vegetables, 1.4 servings of fruit, and 1.2 servings of dairy products. Red and processed meats contribute 50% of total protein intake and are the main source of protein in the patients' diets. In terms of grain consumption, only one-quarter of intake comes from wholegrain products. The reported consumption of fruits and vegetables ranged from 1.6 to 5.9 servings per day, but still, their average intake was below the recommendation of 4.5 servings per day. However, at the individual level, 20% of the study population met the fruit and vegetable consumption recommendations. The obtained results suggest sub-optimal dietary behaviors in people undergoing chronic statin therapy. Thus, public health efforts, along with ongoing diet monitoring, are definitely needed to improve the current knowledge on the impact of massive dietary habits on the overall health of cardiovascular patients.

Keywords: prevention; statin; dietary intake; food groups; recommendations

Author Contributions: Conceptualization, B.D. and M.O.; methodology, M.Z.C. and I.B.; software, J.K.-S.; formal analysis, M.Z.C. and J.K.-S.; investigation, M.Z.C. and I.B.; writing—original draft preparation, M.Z.C.; writing—review and editing, M.Z.C. and V.T.; visualization, V.T.; supervision, M.Z.C. and I.S. All authors have read and agreed to the published version of the manuscript.

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Concept for Preventive Strategy through Optimizing the Nutrition of Pregnant Women in Bulgaria [†]

Peter Markov ¹, Irina Markova ² and Donka Baykova ^{3,*}



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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: Healthy nutrition of pregnant women is a powerful factor for reducing health risks during this period and for the outcome of pregnancy. The objective of the present work is to establish a preventive strategy for pregnant women in Bulgaria by means of a physiologically based nutritional model created upon national and international expert recommendations. Methods: Sociological and documentary methods were used. Results and discussion: The presented strategy concept includes 7 “steps” in the construction and individualization of nutritional regimes for pregnant women by medical professionals. The first step involves the quantitative satisfaction of the women’s increased nutritional energy needs (compared to non-pregnant women of the same age). During the first trimester, women require the following: +70 kcal/day; second trimester: +260 kcal/day; third trimester: up to +500 kcal/day. The second step involves increasing the intake of high-quality protein; during the first trimester, women require +1 g/day; second trimester: +9 g/day; third trimester: +28 g/day. For the third step, fats and carbohydrates do not require additional supplements during pregnancy. For the fourth step, a physiologically justified increase in vitamin and mineral food intake is necessary. As a percentage, the increase is as follows: vitamins A and E: +8%; C and B12: +11%; B1, B2 and niacin (B3): +30%; B6: +46%; A: +60%; folate (B9): +81%; copper: +15%; iodine: +33%; iron and zinc: +50%. The fifth step involves the selection of medico-biological criteria for proper nutrition: weight gain: from 11.5 to 16 kg in healthy women with normal body mass (BMI from 18.5 to 24.9) before the beginning of pregnancy. Overweight women (BMI from 25 to 29.9) should not gain more than 7 to 11 kg; obese women (BMI over 30) should not gain more than 6 to 8 kg; underweight women (BMI < 18.5) should not gain more than 12.5 to 18 kg. The sixth step involves performing a medical assessment for pregnancy-related health problems. The seventh step includes the development of practical recommendations for a healthy diet with a set of products adapted to the specific metabolic needs of the pregnant women and distribution of food intake during the day. Conclusion: The experts in this field should provide medical professionals (involved in the healthcare of pregnant women) with the necessary skills and techniques to implement this preventive strategy in their counseling practices.

Keywords: strategy; optimization; nutrition; pregnant women

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Sugar Replacers in Confectionary beyond Sugar-Free Chewing-Gums: Demonstration of Oral Health Benefits of Polyols in Tablets Using a Customized-Reversed pH-Telemetry Test [†]

Caroline Perreau , Daniel Wils and Clémentine Thabuis *



Citation: Perreau, C.; Wils, D.; Thabuis, C. Sugar Replacers in Confectionary beyond Sugar-Free Chewing-Gums: Demonstration of Oral Health Benefits of Polyols in Tablets Using a Customized-Reversed pH-Telemetry Test.

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sugar-free chewing-gum (SFCG) were largely described in the literature. In addition to the increase in salivary flow and the mechanic effect of CG, their main ingredient, i.e., polyols, can also have some specific benefits on oral health on their own. Some have been shown to have a bacteriostatic effect on acid-producing bacteria, and others have been shown to be particularly active on dental plaque early colonizers, resulting in both a reduction in dental caries prevalence or a decrease in gums inflammation. Here, we aimed to demonstrate these positive effects using the tablet vector only composed of compressed polyols. Methods: We used a customized inversed pH-telemetry test that is often used to demonstrate the

“safe for teeth” characteristics of a food product. This inversed pH-telemetry test was designed to evaluate the potential of a food product to counteract the dental plaque drop in pH following a sucrose challenge, according to the regulatory advised test. It was performed on five healthy volunteers that grew 5-day dental plaque over a micro electrode to measure their pH in situ. Three different tablets were tested: 100% maltitol versus 100% sorbitol versus control tablets (70% starch + 30% resistant dextrin). Results: For each tablet, a neutralization score was calculated as the difference in the pH values (pH values at the end of the consumption of the respective tablets—pH value just before consumption of the tablets). Positive values indicate a neutralization (increase in pH during the consumption of the product), meaning that the neutralization with maltitol tablets was the greatest among tested tablets ($p = 0.003$ vs. control). Sorbitol tablets also had a significant impact ($p = 0.01$ vs. control). Discussion/Conclusions: This inversed pH-telemetry was designed to show a neutralizing effect of polyol tablets as it has been conducted with sugar-free chewing-gums. We demonstrated here that tablets were also able to counteract the dental plaque pH drop induced by a sucrose challenge, showing clearly that tablets should also be considered as oral health beneficial products. Consequently, the consumption of polyols in various vectors should be regulatory, as is recommended for SFCG.

Keywords: polyol; oral health; sweetener

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Abstract: Background and Objectives: Positive impacts of



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Public Procurement of Food Products in Educational Institutions in Slovenia [†]

Neža Fras ¹, Evgen Benedik ^{2,3,*} and Matej Gregoric ¹



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Abstract: Background and objectives: Kindergartens and schools are an important consumer of food in Slovenia nationwide, and they are obliged to the public procurement of food. The aim of this study was therefore to investigate the consideration of nutritional criteria in public food procurement (PFP) and to identify differences in PFP according to the type, size, and region of the educational institution (EI). Methods: In 2021, a total of 535 Slovenian EIs completed a self-administered questionnaire on nutrition-related practices. The use of nutrition criteria and various practices in the PFP was also assessed. To assess statistically significant differences ($p \leq 0.05$), we performed non-parametric Fisher's exact and chi-square tests. Results: In the requirements of the last public tender of food, EIs mainly considered the conditions related to food quality schemes (92.5%), organic production (83.6%), and adequacy of nutritional value (72.2%). When implementing school meals, they were least likely to fully comply with restrictions on the allowable inclusion of foods with low nutritional value (38.5%) and most likely to comply with recommendations on the frequency of the inclusion of recommended foods (47.0%). Most of the EI respondents (74.0%) confirmed that the criteria based on nutrient profiling would be useful for more healthy food products procurement. More requirements on the inclusion of organic production and nutritional adequacy were found among kindergartens than schools. Statistically significant differences in nutritional quality were found between smaller and larger EIs. More requirements on the inclusion of organic production, quality classes, and nutritional adequacy were found among larger compared to smaller EIs. Differences were also found between EIs from three different regions for the inclusion of organic production requirements. Discussion: Healthy PFP policies can improve access to nutritious and healthy food in EI and promote healthy eating habits. The implementation of the healthy PFP was achieved differently at distinct levels. The presented evaluation suggests that different success in implementation might be attributed to different characteristics of individual EI. System changes might also be needed to support and improve the implementation of healthy PFP policies.

Keywords: public food procurement; educational institutions; school nutrition; nutrient profiling; criteria for nutritionally more suitable food products

Author Contributions: Conceptualization, E.B. and M.G.; methodology, E.B. and M.G.; validation, E.B. and M.G.; investigation, N.F.; writing—original draft preparation, N.F.; writing—review and editing, E.B. and M.G.; visualization, N.F.; supervision, E.B. and M.G.; project administration, M.G.; funding acquisition, M.G. All authors have read and agreed to the published version of the manuscript.

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Meeting UK Fibre Intake Recommendations in Food Insecure Households: The Availability of Fibre from Redistributed Surplus Food

†

Neil Boyle ^{1,*} , Flora Larcombe ², Katie Adolphus ¹, Nick Wilkinson ² , Fiona Croden ¹ and Louise Dye ¹



Belgrade, Serbia, 14–17 November 2023.

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† Presented at the 14th European Nutrition Conference FENS 2023,

Abstract: Background: The majority of UK adults are failing to consume the recommended fibre intake levels. Whilst insufficient fibre intake is shown across the population as a whole, it is particularly deficient in low-income households. The cost-of-living crisis has further exacerbated the prevalence of food insecurity, with an increasing number of UK households becoming reliant on redistributed food to supplement their diets. The availability of fibre from this redistributed food is unknown. Objectives: To examine the quantities and sources of fibre available to food insecure households via surplus food redistribution. Methods: 12 months of food processed by a UK surplus food charity was examined to quantify the availability of fibre (grams per 2000 kcal) redistributed to food insecure populations in Leeds. These data were also examined to identify seasonal variation in fibre sources, food groups providing most fibre content, and to quantify the number of ‘sources of’ (SO) and ‘high in’ (HI) fibre foods as a proportion of total food items redistributed. Results: The recommended portion of 30g of fibre per 2000 calories was available for redistribution for 3 out of 12 months in 2022. However, this was due to the sporadic availability of specific individual high fibre snack items, rather than reflective of the balance of diet commonly available. Frequently received SO/HI fibre foods were not donated in large quantities, required complex cooking, or were not nutritionally balanced. There was no seasonal variation in fibre sources evident. Discussion: Redistribution of surplus food can provide critical support to food insecure households. The nutritional balance of this food is largely dependent on the types of foods available for redistribution, so fluctuations in fibre availability is expected. Whilst insufficient to meet the recommended 30g/day of fibre, the food available for redistribution was sufficient to meet and exceed the levels of fibre commonly consumed in the general population (~20 g/day). Insight into the quantity and types of fibre-rich foods available for redistribution can: (i) inform specific interventions (e.g., recipe ideas) to increase the consumption of these available foods, (ii) help identify which types and sources of fibre are not commonly available and should be prioritised.

Keywords: fibre; surplus food; diet quality; low income households; food poverty

Author Contributions: Conceptualization, N.B., F.L., L.D. and K.A.; methodology, N.B., F.L. and L.D.; formal analysis, F.L.; investigation F.L.; data curation, F.L.; writing—original draft preparation, N.B., F.C. and F.L.; writing—review and editing, All; supervision, N.B., L.D., F.C. and K.A.; project administration, N.B. and F.L.; funding acquisition, L.D., N.B. and K.A. All authors have read and agreed to the published version of the manuscript.

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A Mini Review on the Effects of Experimental Design, Including Variations in Participant Baseline Performance, When Testing the Efficacy of Polyphenol Consumption to Enhance Mood and Cognitive Function in Humans from a New Researcher Perspective [†]

Duaa Altuwairki ^{1,*} and Kirsten Brandt ²



Citation: Altuwairki, D.; Brandt, K. A Mini Review on the Effects of Experimental Design, Including Variations in Participant Baseline Performance, When Testing the Efficacy of Polyphenol Consumption to Enhance Mood and Cognitive Function in Humans from a New Researcher Perspective. *Proceedings* **2023**, *91*, 344. <https://doi.org/10.3390/proceedings2023091344>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: This review discusses the implications, from a new researcher’s perspective, of variations in the design, dose and participant age group used and their subsequent effects on the cognitive performance and mood observed in studies investigating the effect of foods rich in phenolic compounds. In this context, ‘new researchers’ design and conduct new exploratory research on this topic, such as testing novel products for these properties. Previous systematic reviews and meta-analyses have concluded that foods rich in phenolic compounds have an enhancement effect on cognition, providing a motive for exploring the benefits of different types of foods with such constituents; however, these benefits were inconsistent across the studies. This has prompted the present review to assess the literature to elucidate the potential causes of the variability in outcomes. One source of variation was inconsistency in the cognitive assessment tools used across studies. Another was participant age, where the positive effects were seen more in elderly populations than in a healthy young population with a high baseline performance. Also, the frequent absence of primary outcome identification and other indications of a less cautious approach to statistical analyses may have contributed to instances of type 1 errors. In conclusion, new researchers should use well-validated assessment tools, study populations with a modest baseline performance, and predefined appropriate statistical procedures to minimize irreproducible outcome variations.

Keywords: experimental design; predefined outcomes; reproducibility; effect size

Author Contributions: Conceptualization, methodology, investigation, writing—original draft preparation, D.A.; writing—review and editing, supervision, K.B. All authors have read and agreed to the published version of the manuscript.

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Assessment of Vitamin D Intake and Status in Slovenian Premenopausal and Postmenopausal Women [†]

Vid Vic^{ic} ^{1,*}, Petra Pavlic¹, Valentina Rok¹, Saša Kugler², Andreja Kukec^{1,2} and Ruža Pandel Mikuš¹



Belgrade, Serbia, 14–17 November 2023.

Citation: Vic^{ic}, V.; Pavlic, P.; Rok, V.; Kugler, S.; Kukec, A.; Mikuš, R.P. Assessment of Vitamin D Intake and Status in Slovenian Premenopausal and Postmenopausal Women. *Proceedings* **2023**, *91*, 333. <https://doi.org/10.3390/proceedings2023091333>

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Abstract: Background and objective: The main source of Vitamin D is the synthesis of cholecalciferol (D3) from 7-dehydrocholesterol in the skin when exposed to ultraviolet radiation. A significant intake can be obtained from supplementation and fortified foods and to a lesser extent from fatty fish and eggs. The objective of our study was to assess vitamin D intake and status in Slovenian premenopausal and postmenopausal women. Methods: A cross-sectional study was conducted between March and May 2021, involving 319 women aged 44 to 65 years. After considering exclusion criteria and the completeness of data, 176 participants were included in the final analysis. Vitamin D status was determined by measuring the concentrations of total 25-hydroxyvitamin D (25(OH)D), vitamin D-binding protein (DBP), and albumin and by calculating bioavailable and free 25(OH)D. Vitamin D intake from fish (fatty and lean separately), eggs, and food supplements or drugs was assessed using a vitamin D-focused food frequency questionnaire (FFQ). In addition, sun exposure, menstrual status, socio-demographic characteristics, and health status were assessed. Results: Vitamin D insufficiency (total 25(OH)D < 75 nmol/L) was observed in 77% of premenopausal and 62% of postmenopausal women. Premenopausal women had 12% lower total 25(OH)D and 32% lower bioavailable 25(OH)D compared to postmenopausal women. The average milk and yoghurt consumption was 135 ± 161 mL/day; egg consumption was 3.2 ± 2.4 eggs/week. The mean vitamin D intakes from food and supplementation were 2.2 ± 1.3 µg/day and 21.7 ± 26.2 µg/day, respectively. In total, 61% of the participants supplemented with a mean dose of 35.4 ± 25.3 µg/day, with no statistically significant differences between premenopausal and postmenopausal women. The odds ratio (OR) for vitamin D insufficiency (25(OH)D < 75 nmol/L) among participants who did not supplement with vitamin D was 6.23; *p* ≤ 0.001. Premenopausal women had a statistically non-significant lower supplementation rate. Discussion and conclusions: Vitamin D status among Slovenian postmenopausal women is significantly more favourable than among premenopausal women. Despite a high supplementation rate, vitamin D insufficiency is still present in the majority of the population. With limited milk consumption, milk fortification alone is not feasible. However, egg biofortification could offer a viable contribution to increasing vitamin D intake.

Keywords: vitamin D; 25(OH)D; postmenopausal; premenopausal; epidemiological study

Author Contributions: Conceptualization, V.V., A.K., and R.P.M.; investigation: V.V., P.P., V.R. and S.K.; writing: V.V. and S.K.; reviewing: V.V., A.K., R.P.M., P.P., V.R. and S.K.; supervision: A.K. and R.P.M. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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The VEGANScreener Project: The Protocol for the Clinical Observational Study [†]

Tooba Asif ^{1,*}, Stefaan De Henauw ¹, Jan Godja ² , Anna Ouradova ², Selma Kronsteiner Gicevic ³,
Willem De Keyzer ¹ and Ainara Martinez Tabar ⁴



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updates

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Abstract: Background and Objectives: Consumption of plant-based diets, including vegan diets, requires attention towards diet quality and the early detection and prevention of nutritional deficiencies. The VEGANScreener project aims to develop and validate a standardized brief web- and app-based screening tool to assess and monitor diet quality among vegans in Europe. To this end, a clinical study will be performed to evaluate the VEGANScreener against a reference diet assessment method and nutritional biomarkers. Materials and Methods: An observational cross-sectional study will comprise six hundred participants across four European sites (Germany, Spain, Belgium, Czech Republic): 400 self-reported vegans (≥ 2 years on vegan diet) and 200 self-reported omnivore controls; without diseases affecting the metabolism and intestinal integrity; aged 18 to 65 years (1:1 ratio 18–35 and 36–65); males and females (1:1 ratio). Subjects will be enrolled after an online eligibility check. Informed consent will be obtained, and the subjects enrolled will be given a unique ID (pseudonymized). The initial clinical visit consists of structured medical history-taking, blood pressure, heart rate and anthropometric measurements, blood, spot urine and saliva sampling, distributing the VEGANScreener access, diet record instructions, and general survey access. A follow-up collection visit will be scheduled 14–21 days apart: 24 h urine and 4-day diet records will be collected, and subjects' participation will be terminated. VEGANScreener will be administered twice to limit the within-person errors. Results: Field work is ongoing, and we expect to have results by the time of the conference. Discussion: The VEGANScreener tool will be validated for the target population. The primary objective is to assess the construct validity and criterion validity of the VEGANScreener through associations of the score with nutrient intakes from a 4-day diet record and associations with biomarkers of dietary intake. Standard statistical models will be implemented for cross-sectional comparisons of geographical groups. Secondary outcomes will include analyses of dietary data and metabolomics. Vegan subgroups will be identified with dimensionality reduction methods and univariable statistical tests. Major nutrient sources and variations across groups will be assessed. Exploratory metabolomic analysis (blood, urine, saliva) to identify novel concentration biomarkers of dietary intake and nutritional adequacy will be performed using multivariable analysis.

Keywords: plant-based diets; vegan diets; diet quality; nutritional deficiencies; VEGANScreener project; web-based screening tool; app-based screening tool; diet assessment; nutritional biomarkers; nutritional adequacy

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Author Contributions: Conceptualization, J.G. and S.K.G.; methodology, A.O.; software, J.G.; validation, S.D.H.; formal analysis, W.D.K. and J.G.; investigation, S.K.G.; resources, S.D.H.; data curation, A.M.T.; writing—original draft preparation, J.G.; writing—review and editing, T.A. and A.O.; visualization, W.D.K.; supervision, S.D.H.; project administration, S.K.G.; funding acquisition, S.K.G. and S.D.H. All authors have read and agreed to the published version of the manuscript.

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29/3); the German Funding Foundation DFG (Germany, project no. 01EA2202), and the Spanish Ministry of Science and Innovation-EU Next Generation Funds (Spain, project no. AC21_2/00015).

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Institutional Review Board Statement: The study will be conducted in accordance with GCP and the declaration of Helsinki. The study protocol was approved by the following institutional review boards: KVUH ethical board (EK-VP03/0/2022), UNAV (2022.120), IFPE (AZ 37/23), UGent (ONZ-2023-0169), Cantonal Ethic Committee Zurich (2023-01112).

Informed Consent Statement: Informed consent will be obtained from all subjects involved in the study.

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The Updated Algorithm of Front-of-Pack Label Nutri-Score Is Not in Line with Dutch Food-Based Dietary Guidelines: Results of Calculations with Dutch Food Composition Database [†]

Jacco Gerritsen ¹, Hans Verhagen ²  and Stephan Peters ^{1,*} 



Keywords: Nutri-Score; front-of-pack label; algorithm; food-based dietary guidelines; wheel of five

Citation: Gerritsen, J.; Verhagen, H.; Peters, S. The Updated Algorithm of Front-of-Pack Label Nutri-Score Is Not in Line with Dutch Food-Based Dietary Guidelines: Results of Calculations with Dutch Food Composition Database. *Proceedings* 2023, 91, 326. <https://doi.org/10.3390/proceedings2023091326>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Background and objectives: The front-of-pack label Nutri-Score has met a lot of scientific opposition. In the Netherlands, these were major concerns that Nutri-Score was not in line with the Dutch food-based dietary guidelines. In 2022, the algorithm behind the Nutri-Score was updated with the intention to bring it more in line with the general European food-based dietary guidelines. **Methods:** In this study, the renewed 2022 algorithm for solid foods is applied to the Dutch Food Composition Database (NEVO) to calculate the Nutri-Score values. Subsequently, the Nutri-Score values of all-solid foods were compared to the Dutch food-based dietary guidelines (the Wheel of Five). The foods that are included in the Wheel of Five are considered as “healthy”, i.e., would qualify for labels A or B, while the foods that receive labels C/D/E are considered “unhealthy”. **Results:** In total, 1980 solid foods were selected from NEVO. Despite the intended outcome, 19% of the unhealthy (non-Wheel of Five) products still received a Nutri-Score A or B. In addition, 25% of the healthy products in the Wheel of Five were scored as “unhealthy”, i.e., Nutri-Scores C/D/E. So grossly, circa one quarter of the foods will be wrongly labelled if the new algorithm is applied. **Discussion:** If the Nutri-Score is applied with the updated algorithm, this will mean that an average supermarket in the Netherlands will contain thousands of products with an inappropriate score. These results confirm the worries of the >200 Dutch food scientists and the associations of dietitians, life style coaches and weight councilors that the Nutri-Score will confuse Dutch consumers upon introduction. In their request to the Dutch Ministry of Health, they suggest to first bring the Nutri-Score essentially in line with our Wheel of Five before introducing the Nutri-Score system in the Netherlands. The full details of this work can be found at doi 10.13140/RG.2.2.23262.31043.

Author Contributions: J.G.: Conceptualization; Data curation; Formal analysis; Methodology; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. H.V. and S.P.: Methodology; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: J.G. and S.P. are employed at the Dutch Dairy Association. H.V. is an independent consultant at the Food Safety & Nutrition Consultancy (The Netherlands) and holds professorships at the Technical University of Denmark (Denmark) and the University of Ulster (Northern Ireland). No author has a

past or current collaboration with the Nutri-Score. H.V. is a member of the international board of the Choices International Foundation since 2023. Until 2015, Both S.P. and H.V. were members of the independent scientific committee in the Netherlands supporting the former front-of-pack logo “het Vinkje”. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The Dutch Dairy Association is involved in the national discussion in the Netherlands about front-of-pack logos by submitting inputs into product reformulations and front-of-pack consultations of the Dutch Ministry of Health, Welfare and Sport.

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Exposure to Dietary Salt through Nutrition in Public Preschools in Belgrade †

Dunja Koprivica *, Vesna Pantić-Palibrk, Maja Ristic', Stefanija Nikolic' and Danica Stošić'



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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background: Widespread overconsumption of food high in salt is linked to various adverse health conditions. Children are especially susceptible and exposed to these nutritional trends. Nutrition within preschool facilities is an important influence in adopting healthy dietary habits at an early age. Belgrade public preschools provide daily meals for around 50,000 children. As they are of recognized importance, nutritional requirements for preschools in Serbia are set out by regulations. The Institute of Public Health of Belgrade conducts continuous surveillance of nutrition in public preschools in Belgrade. Objective: To gain insight in to an important aspect of nutrition, i.e., the food served in public preschools in Belgrade. Method: Analysis of data, i.e., results of chemical–bromatological analysis of meals sampled in public preschools in Belgrade from 31 January 2018 to 31 December 2022. Statistical analysis was conducted using IBM SPSS 22.0. Results: Overall, 3917 whole day meals (comprising breakfast, lunch and snack) were analyzed for salt content (NaCl). Meal samples were taken from two age groups—1 to 3 years ($n = 1351$) and 4 to 7 ($n = 2566$). The findings of the study show that the average salt content across the observed period exceeded the upper values set by the regulation in both age groups— 3.57 ± 1.17 g in the 1-to-3-years age group and 4.54 ± 1.12 g in the 4-to-7-years age group. Less than 5% of tested samples had a salt content within the defined limits (around 4.9% in both age groups). Seasonal variations in salt content in meals have been determined as well as significant statistical differences between the years of the observed period. Discussion: A positive trend is observed in terms of a gradual, discrete reduction in salt in preschool meals throughout the observed period. As joint efforts at the local level show moderate improvements, further actions are needed with the inclusion of other stakeholders (state authorities, industry, etc.) with the aim of providing the healthiest diet for children attending preschools.

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Keywords: preschool nutrition; salt; surveillance

Author Contributions: Conceptualization, D.K. and V.P.-P.; methodology, D.K.; formal analysis, D.K.; resources, D.K. and D.S.; data curation, D.K., M.R., S.N. and D.S.; writing—original draft preparation, D.K.; writing—review and editing, V.P.-P. and M.R.; visualization, D.K.; supervision, V.P.-P. All authors have read and agreed to the published version of the manuscript.

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Assessment of the Salt Content in Breads in Slovenia [†]

Saša Kugler ^{1,*}, Hristo Hristov ² , Urška Blaznik ¹ and Igor Pravst ² 



Citation: Kugler, S.; Hristov, H.; Blaznik, U.; Pravst, I. Assessment of the Salt Content in Breads in Slovenia. *Proceedings* **2023**, *91*, 292. <https://doi.org/10.3390/proceedings2023091292>

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Abstract: Background and objectives: Reducing salt intake

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is among the most cost-effective measures for reducing the burden of non-communicable diseases. To effectively reduce intake, salt reduction strategies often concentrate on food categories that contribute the most to overall salt intake. In Slovenia, bread is recognized as one of the contributors to salt intake and efforts are being made to reduce its salt content. Therefore, the objective of this study was to assess the current salt content of bread sold in large retail shops and smaller bakeries in Slovenia. **Methods:** The study was conducted in November/December 2022. A total of 178 bread samples were purchased across 11 statistical regions of Slovenia, both in large retail shops and smaller bakeries. The sampling in large retail shops covered all main bread categories and considered statistical consumption data. The final sample included 60 white wheat breads, of which 28 were purchased in large retail shops. Other categories included mixed wheat (N = 33), dark wheat (N = 16), half-white wheat (N = 12), and rye bread (N = 3). The sampling in smaller bakeries was limited only to white and wholegrain bread, where available. Sodium content was determined by inductive coupled plasma mass spectroscopy (ICP-MS). Salt content was calculated by multiplying it by 2.54, assuming that all sodium corresponded to sodium chloride (NaCl). **Results:** The average salt content of white wheat bread sold in large retail shops was 1.21 ± 0.16 g NaCl/100 g. The average salt content of dark wheat, half-white, and mixed bread was similar (1.15 ± 0.14 g NaCl/100 g, 1.23 ± 0.13 g NaCl/100 g, and 1.22 ± 0.24 g NaCl/100 g, respectively). On the other hand, wheat bread from smaller bakeries had an average salt content of 1.34 ± 0.21 g NaCl/100 g (range 0.85–2.06 g/100 g). **Discussion:** The results suggest a slight reduction in the average salt content of mixed wheat, dark wheat, half-white wheat, and rye bread from large retail shops, compared to a study conducted in 2010. These findings emphasize the importance of ongoing efforts to improve the composition of bread and the need for continued focus on salt reduction strategies.

Keywords: bread; salt content; ICP-MS

Author Contributions: Conceptualization, S.K., U.B., H.H. and I.P.; methodology, H.H. and I.P.; formal analysis, H.H.; investigation, H.H. and I.P.; data curation, H.H.; writing—original draft preparation, S.K.; writing—review and editing, S.K., U.B., H.H. and I.P.; supervision, U.B. and I.P.; funding acquisition, I.P. All authors have read and agreed to the published version of the manuscript.

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Dietary Patterns of Serbian Adults 10–74 Years Old: Serbian National Food Consumption Survey Following EU Menu Methodology[†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Increasing rates of adult overweight (60.7% population) and diet-related cardiovascular diseases (52% population) in Serbia alarmingly call for a change in dietary patterns. To be able to identify problems and solutions, harmonized and comparable food consumption data are needed. The European Food Safety Authority (EFSA) provided support and guidance, through the EU Menu program, for conducting the Serbian National Food Consumption Survey on adults from 10 to 74 years old, including pregnant women and vegetarians in the period of 2017–2022. This work gives an overview of the quantity, energy intake, and distribution across different food groups, which are all basic parameters of dietary patterns, aiming at comparing the actual diet with recommendations—the EAT Lancet Commission Report. Methods: Food consumption data were collected from 3018 participants: 856 adolescents aged 10–17 years, 1155 adults aged 18–64 years, 581 elderly subjects aged 65–74 years, 145 pregnant women, and 281 vegetarians, using two inconsecutive days repeated 24 h dietary recall. The advanced nutritional software, Diet Assess and Plan (DAP), was applied for data storage, processing, and reporting, while the Serbian Food composition database was used as a resource for food composition information of the foods and recipes consumed in the survey. Results: In the adult population, quantitatively, the most consumed foods are as follows: vegetable and vegetable products (312 g/day), milk and milk products (247.7 g/day), fruit and fruit products (245.7 g/day), grain and grain products (215.8 g/day), and meat and meat products (166.08 g/day). Liquids—water and non-milk beverages—were consumed 1511 g/day on average. However, the mean distribution of energy intake differs significantly. The main source of energy comes from grain and grain products (637.5 kcal/day (29.3%TE)), meat and meat products (355.4 kcal/day (16.3%TE)), fats and oils (271 kcal/day (12.4%TE)), and milk and milk products (261.3 kcal/day (12%TE)). Discussion: The energy distribution and consumed quantities of some food groups indicate that actual diet, comprised of processed grains, meat, and fatty food, is not meeting reference healthy diet recommended in EAT Lancet Commission Report, and present a risk factor for the development of overweight, obesity, and diet-related cardiovascular diseases in the Serbian population.

Keywords: food consumption; dietary patterns; EU menu; nutritional inadequacy

Author Contributions: Conceptualization, J.M. and M.G.; methodology, M.G., M.Z., J.M.; software, M.G.; validation, I.Š., I.K., M.K. and M.Z.; formal analysis, J.M.; investigation, J.M.; I.Š., M.K., M.Z., I.K., V.S., resources, M.G.; data curation, J.M.; writing—original draft preparation, J.M.; writing—review and editing, I.Š.; visualization, J.M.; supervision, M.G.; project administration, M.Z.; funding acquisition, M.G. All authors have read and agreed to the published version of the manuscript.

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Utility of a Qualitative, Dietary ‘Self-Monitor Your Diet’[®] Diary to Improve Diet Quality and Compliance with Dietary Recommendations[†]

Lidia Wadolowska

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background/objectives: No matter how simple dietary recommendations are, many people find it difficult to follow them in the long run. This study tested the utility of a qualitative, dietary diary, entitled ‘Self-Monitor Your Diet’[®], in order to improve diet quality and compliance with dietary recommendations. Methods: The sample consisted of 84 university females (Poland), aged 20.4 ± 2.0 years. To monitor food consumption, the ‘Self-Monitor Your Diet’[®] was used. The diary contains eleven food items, including six items recommended for consumption and five items with limited consumption, along with the recommended consumption frequencies per day/week/month. The respondents completed the diary for two consecutive months (M1; M2). The average daily consumption frequency (times/day) of each food item was calculated. The respondents’ adherence to the dietary recommendations was expressed as an Adherence Score (AdhS) in points (range 0–12), with one point per compliance to each recommendation. More points were awarded for better compliance with dietary recommendations. Body Mass Index (BMI) and waist-to-hip ratio (WHtR) were calculated on the basis of measurements taken twice (before the diary completion and after 2 months). Results: For the M1 diary, AdhS within 0–2 points were found in 9% of respondents, 2–4 points in 36%, 4–6 points in 42%, 6–8 points in 12%, and 8–10 points in 1%. For the M2 diary, more subjects fell in higher ranges of AdhS: 4%, 36%, 38%, 20%, 2%, respectively ($p = 0.0009$). AdhS for the M2 diary averaged at 4.1 points (SD 1.7), and, for the M1 diary, 3.8 points (SD 1.8) ($p > 0.1$). More subjects consumed fruit/vegetables ≥ 5 times/day in M2 than M1 (50% vs. 1%, respectively; $p < 0.0001$) and sweetened beverages/energy drinks \leq once a week (61% vs. 42%, respectively; $p = 0.0061$). There were no differences in the average BMI or WHtR between the first and second data collections. Discussion/conclusions: The diary, based on the user’s own activity, can be useful in monitoring day-by-day dietary habits and promoting diet quality improvement, especially with respect to fruit and vegetables.



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Keywords: diet monitoring; dietary recommendation; diet-related diseases; food frequency consumption; food-based dietary guidelines

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Contribution of Plant-Based Dairy and Fish Alternatives to Iodine Nutrition in the Swiss Diet—A Swiss Market Survey [†]

Isabelle Herter-Aeberli *  and Zulekha Khalil



Citation: Herter-Aeberli, I.; Khalil, Z. Contribution of Plant-Based Dairy and Fish Alternatives to Iodine Nutrition in the Swiss Diet—A Swiss Market Survey. *Proceedings* **2023**, *91*, 264. <https://doi.org/10.3390/proceedings2023091264>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: In Switzerland, , 264. <https://doi.org/10.3390/proceedings2023091264> , 264

conventional dairy and fish products are major sources of iodine, along with iodized salt. However, the growing popularity of plant-based alternatives may impact the iodine supply of the population. This study aimed to comprehensively assess the iodine content in plant-based dairy (milk, yogurt, and cheese) and fish alternatives available in the Swiss retail market and compare them with conventional dairy and fish products. **Methods:** In 2022, a market survey was conducted in Zurich, Switzerland, to identify the plant-based dairy and fish alternatives available in major retail outlets, online grocery stores, and health food stores. Product information from a total of 477 plant-based alternative products was recorded. Iodine content in unfortified alternatives was factorially calculated using the nutritional composition of plant ingredients listed in the Swiss Food Composition Database. To further comprehend the impact of plant-based alternatives on iodine consumption, we modelled dietary scenarios by substituting the intake of dairy and fish items with plant-based alternatives, based on the recommendations of the Swiss Food Pyramid. **Results:** Out of the 477 products identified, 58% were organic products. Only 4 out of 170 milk alternatives were iodine fortified (mean iodine concentration: 22.5 µg/100 mL), and there were no yogurt, cheese, or fish alternatives that were iodine fortified. The median iodine concentration in unfortified plant-based alternatives was negligible compared to conventional dairy and fish products (milk: 0.21 vs. 9.5 µg/100 mL; yogurt 0.36 vs. 6.1 µg/100 g; cheese: 0.10 vs. 20 µg/100 g; fish 0.50 vs. 44 µg/100 g). Three portions of dairy per day as recommended by the Swiss Food Pyramid provide 25% of the RDA (150 µg/day), whereas substituting three portions of dairy per day with unfortified alternatives provides only 0.7% of the RDA for iodine. **Discussion:** Only 4 out of 170 plant-based milk alternatives are iodine-fortified in the Swiss market, while no fortified yogurt, cheese, or fish alternatives are available. Thus, the risk of the consumers to miss out on the ca. 25% of the RDA for iodine by consuming plant-based alternatives is high, placing them at a risk for inadequate iodine intake.

Keywords: plant based alternatives; milk; dairy; fish; iodine; fortification

Author Contributions: Conceptualization, I.H.-A.; methodology, I.H.-A. and Z.K.; formal analysis, Z.K.; investigation, Z.K.; resources, I.H.-A.; data curation, Z.K.; writing—original draft preparation, Z.K.; writing—review and editing, I.H.-A.; supervision, I.H.-A.; project administration, I.H.-A. All authors have read and agreed to the published version of the manuscript.

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Trends in Sweetness of the Diet in the United Kingdom: 2008/9 through 2018/19 [†]

Inga Kutepova ^{1,*} , Alison Kamil ², Alissa R. Wilson ¹ and Colin D. Rehm ³ 



Citation: Kutepova, I.; Kamil, A.; Wilson, A.R.; Rehm, C.D. Trends in Sweetness of the Diet in the United Kingdom: 2008/9 through 2018/19. *Proceedings* **2023**, *91*, 261. <https://doi.org/10.3390/proceedings2023091261>

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Abstract: Reducing sugars consumption is an important public health priority. Because reducing one's sugar intake is

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challenging, some organizations have suggested reducing the consumption of all sweet-tasting foods and beverages, regardless of the source of the sweet taste (i.e., caloric or low/no calorie sweeteners (LCSs)), due to the assumed correlation between dietary sweetness and sugars intake. Descriptive data summarizing patterns and trends in the overall sweetness of the diet may help inform dietary recommendations. For this cross-sectional study, dietary information was collected from 15,655 participants aged ≥ 1.5 year, as part of the National Diet and Nutrition Survey Rolling Programme (NDNS RP) over the course of four consecutive days between 2008/09 and 2018/19. Products that were sweetened with LCS were matched to their sugar-sweetened equivalents (e.g., a regular beverage with sugars and a diet beverage with LCS). The amount of sweetness in an individual's diet was quantified in terms of grams of ASE (approximate sugar equivalent) per day. During the study period, the ASE of the diet declined by approximately 10%. The estimated ASE of the diet per 2000 calories was 96.7 g/d for children and 113.8 g/d for adults. Approximately one-fifth of the total ASE was from LCSs. There was evidence of a non-linear trend over time, with ASE levels remaining relatively stable between 2008/09 and 2014/15, and then declining. The amount of ASE coming from LCS sources increased, going from 8g/d to 12.6 g/d. The overall change in total sugars and ASE was more apparent for beverages compared to foods (ASE values decreased by 20.7% for beverages vs. 4.4% for foods), but both decreased significantly. In the UK, there has been a shift in both the overall sweetness of the diet, as well as the total amount of sugars consumed. This is partly attributable to the reformulation of products, as well as changes in preferences among consumers. According to the findings of this study, the sweetness levels in the diets of the UK population are declining over time.

Keywords: sweetness; sweeteners; cross-sectional studies; trends; United Kingdom; the National Diet and Nutrition Survey

Author Contributions: Conceptualization, A.R.W., C.D.R., A.K. and I.K.; methodology, A.R.W., C.D.R. and A.K.; software, C.D.R.; validation, C.D.R. and I.K.; formal analysis, C.D.R.; investigation, C.D.R. and I.K.; resources, C.D.R.; data curation, C.D.R. and I.K.; writing—original draft preparation, C.D.R. and I.K.; writing—review and editing, A.R.W., C.D.R., A.K. and I.K.; visualization, C.D.R.; supervision, C.D.R.; project administration, IK; funding acquisition, A.R.W. and C.D.R. All authors have read and agreed to the published version of the manuscript.

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Dietary and Supplement Intake of Lutein and Zeaxanthin: How Much Do We Get and How Much Do We Need? †

Susan Hazels Mitmesser * , Qian Ye, Prasad P. Devarshi and Ryan W. Grant



Citation: Mitmesser, S.H.; Ye, Q.; Devarshi, P.P.; Grant, R.W. Dietary and Supplement Intake of Lutein and Zeaxanthin: How Much Do We Get and How Much Do We Need? *Proceedings* **2023**, *91*, 217. <https://doi.org/10.3390/proceedings2023091217>

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Abstract: Background and objectives: Lutein and zeaxanthin (L+Z) are carotenoids highly concentrated in the

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macula to maintain macular pigment optical density (MPOD) throughout the lifespan. Studies have shown that an intake of 6–20 mg or higher of L+Z would be beneficial for visual function and cognition. The human body cannot synthesize L+Z and must obtain them from other sources.

Objective: To determine the nutrient intake status of L+Z in US children (6–18 years) and adults (19–64 years), and how dietary supplements contribute to the total intake level of L+Z. **Methods:** Data from NHANES 2003–08 cycles were used to estimate the mean intakes of L+Z from food and food + supplements (F+S). Children and adults were analyzed according to age groups: 6–8 years, 9–13 years, and 14–18 years for children, and 19–30 years, 31–50 years, and 51–64 years for adults. **Results:** In adults ($n = 8252$), the mean (SE) dietary intake of L+Z from food was 1.322 mg (0.040), which was similar to the intake from F+S: 1.396 mg (0.041). For both adult men and women, the mean intake increased by age, with the lowest intake of 1.047 mg (0.039) from food in adult women aged 19–30 years, and the highest intake of 1.700 mg (0.069) from F+S in adult men aged 51–64 years. In children ($n = 7429$), the mean (SE) intake of L+Z was 0.743 mg (0.026) from food, and 0.748 mg (0.026) from F+S. The intake levels among all age groups in children were similar, with the lowest intake of 0.686 mg (0.028) from food in girls 14–18 years, and the highest intake of 0.801 mg (0.038) from F+S in boys 9–13 years. **Discussion:** We found that the dietary intake levels of L+Z in US were much lower than levels recognized to support brain and eye health. Supplementation only marginally increased the total intake, which may indicate a lack of consumer awareness. Efforts are needed to raise public awareness of the health benefits of L+Z and encourage more consumption of L+Z-containing food (dark leafy greens and yellow or orange fruits/vegetables) and supplements by establishing dietary guidance for L+Z. This research was funded by Pharmavite LLC.

Keywords: lutein; zeaxanthin; NHANES; nutritional status; dietary intake; supplement; children; adults; visual; cognition

Author Contributions: Conceptualization, S.H.M., Q.Y. and R.W.G.; methodology and analysis, Q.Y. and P.P.D.; data interpretation, S.H.M., Q.Y. and R.W.G.; writing, review, and editing, S.H.M., Q.Y., P.P.D. and R.W.G. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from NHANES participants by NCHS.

Data Availability Statement: The datasets analyzed during the current study are available in the NHANES repository at the following links: NHANES 2003–2004: <https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2003>; NHANES 2005–2006: <https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2005>; NHANES 2007–2008: <https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx?BeginYear=2007>.

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Nutritional Adequacy and Protein Intake in Older Adults at Risk of Undernutrition with Subjective Memory Decline Enrolled in the Protein-Enriched Mediterranean Diet, with or without Exercise (PROMED-EX) Trial [†]

Nicola Ann Ward ^{1,*} , Lorraine Brennan ² , Lisette C. P. G. M. de Groot ³ , Federica Prinelli ⁴ ,
Dorothee Volkert ⁵, Jayne V. Woodside ¹  and Claire T. McEvoy ^{1,6}



Citation: Ward, N.A.; Brennan, L.; de Groot, L.C.P.G.M.; Prinelli, F.; Volkert, D.; Woodside, J.V.; McEvoy, C.T.

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Older adults are vulnerable to undernutrition, resulting in weight loss and adverse health outcomes, including a loss of independence and a lower quality of life. Adequate protein intake is particularly important for the maintenance of muscle health during ageing. The UK population reference intake for protein (0.75 g/kg/day) may not be sufficient to counteract the reduced responsiveness of older skeletal muscle to anabolic stimulus. Research suggests that 1.2 g/kg/day of protein may be optimal, considering distribution (25–30 g/meal) and leucine-rich sources typically found in animal protein, especially for those at high nutritional risk. PROMED-EX is a randomised controlled trial testing a PROtein-enriched MEDiterranean Diet, with or without Exercise on nutritional status and memory, in older adults (60+) at risk of undernutrition, with subjective memory decline. The current aim is to determine the baseline nutritional adequacy of adults enrolled in PROMED-EX. Participants completed 4-day food diaries at baseline. Diaries were analysed for energy and nutrients using Nutritics. Nutritional adequacy was determined by comparing sex- and age-specific UK dietary reference values (DRVs). Protein intake was also compared to higher recommended DRVs for older adults. Fifty participants (60% female; age 67 ± 6.0 years; BMI: 23.5 ± 2.8 kg/m²) were included. Insufficient energy intake in men (1803.4 ± 510.7 kcal/d) and women (1776.2 ± 508.7 kcal/d) in the sample, with 22.0% meeting the energy DRVs. The risk of nutrient inadequacy was highest for fibre and vitamin D, with almost all failing to meet the DRVs. Less than 50% met nutritional adequacy for vitamin A, iodine, iron, magnesium, potassium, and selenium. Over 35% had suboptimal intakes for selected B vitamins (niacin, folate) and calcium. Most (82%) of the sample achieved the UK protein target of 0.75 g/kg/day, with only 34% meeting the higher 1.2 g/kg/day target. The mean protein intake was less than optimal for breakfast (12.3 ± 7.0 g) and lunch (17.1 ± 8.8 g), accounting for 17.3% and 24.1% total daily protein intake, and highest at dinner time (48.2%) at 34.3 ± 18.3 g. The primary protein contributors were 'cereals' (15.7%), followed by 'dairy' (14.9%), 'processed meat' (10.9%), 'poultry' (10.8%), and 'red meat' (10.5%). Increasing protein intakes at breakfast and lunch alongside leucine-rich sources could help achieve the optimal protein intake. The nutrient-dense PROMED-EX intervention may be beneficial for this at-risk population with suboptimal nutrient intakes.

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Keywords: undernutrition; subjective cognitive decline; dietary reference values; older adults; protein

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data available under request.

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Simple Model for Estimating the Dietary Intake of Dietary Fibre †

Blaž Ferjancič*, Mojca Korošec and Jasna Bertonec



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Abstract: Dietary fibre is an essential part of healthy human nutrition. However, due to the changes in the definition of dietary fibre in 2009, we are still struggling to update the data about dietary fibre content as

data obtained with methods that include all dietary fibre components are scarce. This problem is transferred to nutritional studies worldwide and impairs the quality of monitoring the dietary intake of dietary fibre. The aim of our work was to develop a simple yet acceptably accurate model for dietary fibre intake based on analytical data. Based on the national study SI.Menu 2017/2018 we collected the frequency of food items eaten in the food groups that contribute the most to dietary fibre intake. From these groups, the most frequent foods were selected and analysed for dietary fibre content using AOAC methods 991.41 and 2011.25. After obtaining the results, the data were used in our “forced choice” model. The model was created on the data of food intake for 392 people. The cumulative intake of six food groups (vegetables, fruits, grains and grain products, potato and potato products, legumes and nuts) was known; therefore, we could calculate the share of each food selected to the total food group intake. Having calculated the daily intake for each food, analytical data were applied. This allowed us to calculate the daily intake of dietary fibre. The calculated daily intake was 17.6 g/day using data obtained with the AOAC 991.43 method. The daily intake estimated with data obtained with the AOAC 2011.25 method was 34.3 g/day. In order to evaluate our model, the daily intake of dietary fibre was compared with that in another study based on the same population. Our estimation based on 45 food items was only 10.6% lower than the estimation based on all food items reported by people included in the other study. Therefore, we conclude that our simple model can provide a rough estimate based on analytical data and can serve as a good tool to update research on the daily intake of dietary fibre.

Keywords: dietary fibre; intake; model; AOAC 2011.25; AOAC 991.43

Author Contributions: Conceptualization, B.F., M.K. and J.B.; methodology, B.F. and J.B.; software, B.F.; validation, B.F., M.K. and J.B.; formal analysis, B.F.; investigation, B.F.; resources, M.K. and J.B.; data curation, B.F.; writing—original draft preparation, B.F.; writing—review and editing, M.K. and J.B.; visualization, B.F.; supervision, J.B.; project administration, J.B.; funding acquisition, J.B. All authors have read and agreed to the published version of the manuscript.

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A Review of Food-Based Dietary Guidelines: Are Iconographies Representing Sustainability? †

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Abstract: Background and objectives: The food-based dietary guidelines (FBDGs) are primarily intended to promote healthy diets, and little is known about specific references to the multidimensional aspects of sustainability in their iconographies. Therefore, the objective of this study is to review the existing FBDGs iconographies according to the four sustainability dimensions (nutrition-health, socio-cultural, environmental, and economic) and evaluate to what extent these tools include different sustainability indicators. Methods: FBDGs were collected from the FAO repository and government's official websites in January 2023. Only the latest FBDG editions targeting the general population were included in the study. Non-governmental iconographies addressing macrogeographical areas were also analysed. Sustainability indicators ($n = 30$) were chosen from a preliminary literature review from the four sustainability dimensions. Visual analysis was performed. Results: In total, 191 iconographies were found. The health dimension was the most represented, being present in all iconographies with at least one indicator, followed by the socio-cultural dimension. The environmental dimension was present in 29.8% of the iconographies, while the economic dimension was the least mentioned (1.6%). Globally, the main health indicators were diet diversity (99%), healthy lifestyle (79%), and the avoidance of critical nutrients (71%). Culinary practices (76%) and traditional products (71%) were the most represented within the socio-cultural pillar. Only three iconographies included affordability/costs to consumer as an economic indicator. Those indicators that no iconography mentioned were related to food consumption outside the home, gender, migrants, and fair trade. The more recent the iconography, the greater the presence of sustainability dimensions and indicators. Higher-income countries had a greater presence of health and environmental sustainability indicators, while lower-income countries highlighted more socio-cultural and economic aspects. Discussion: These results are consistent with those retrieved from the literature analysing the main FBDG documents, but present new and complementary information. As the practicality, affordability, availability, and access to healthy and sustainable foods are the main barriers to compliance with dietary guidelines, more focus should address these factors. These results offer an opportunity for technicians and policymakers for adding more sustainability aspects to improve the iconographies while keeping them easy and intuitive.

Keywords: food-based dietary guidelines; healthy and sustainable diets



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Evaluation of the Emergency Meal Kitchen Menus Meeting the Daily Nutritional Requirements [†]

Osman Güldemir 

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: On 6 February 2023, two major and subsequent aftershocks were experienced in Kahramanmaraş, in Türkiye. In these earthquakes, disasters occurred in the provinces of Kahramanmaraş, Hatay, Gaziantep, Osmaniye, Malatya, Adana, Diyarbakır, Şanlıurfa, Adıyaman and Kilis. More than 40,000 people lost their lives. The day after the earthquakes, disaster/emergency kitchens were created in these cities through the initiatives of various institutions and organizations. One of these kitchens is “Anadolu Cuisine”, where Anadolu University operated until 2023. Every day, approximately 15,000 people benefited from the emergency kitchen located in the Belen district of Hatay. In the study, the task of meeting the daily requirements of adults who eat at this kitchen was evaluated. For this, the breakfast, lunch, and dinner menus served in the emergency kitchen were followed on site by the researcher for a week, examining the amounts offered to one person. Then, the energy and nutritional values of the menus were calculated using the nutrition information system. Then, these values were evaluated using the Türkiye Nutrition Guide 2022 reference values. As a result, the energy intake of adults fed from the emergency kitchen was found to be sufficient; it has been determined that the recommended daily intake of important minerals and vitamins such as calcium and vitamin E, D, C cannot be met. In addition, it has been observed that the daily water consumption of individuals is insufficient. Moreover, to all these factors, it has been understood that those with chronic diseases have difficulties in accessing the special foods they need. In such crisis situations, it is recommended to develop strategies for community nutrition and to implement them with immediate coordination.

Keywords: earthquake; disaster kitchen; crisis kitchen; disaster nutrition; soup kitchen; nutrition assessment; energy intake; nutritional value; daily intake; food consumption



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Vitamin D and Cardiovascular Disease Risk: Using Outcomes to Guide Future Nutrition Science [†]

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Abstract: Despite positive associations between micronutrient intake, status, and health outcomes, many randomized controlled trials (RCT) of vitamins are null. Standards to establish causality in biological systems include the Bradford Hill criteria, the experimental component of which relies on and promotes RCT-centred approaches. Such criteria may need adaptations to the specificities of nutrition science. Our objective, as part of a broader FENS initiative to improve the science of nutrition, was to conduct a case study to assess the Bradford Hill criteria (BHC) applied to clinical studies of vitamin D and cardiovascular disease endpoints and evaluate strengths and pitfalls for this approach. We conducted a systematic review of the recent literature on CVD and vitamin D supplementation, including both RCT, cohort studies (CT), or systematic reviews within Medline,

Web of Science, and Cochrane libraries. Studies had to be conducted in adults, including hard CVD-relevant endpoints with a minimum sample size of $n = 500$ for RCT and $n = 10,000$ for CT. CT had to utilize quality-assured, analytical methods for serum 25-hydroxyvitamin D assessment and include verified clinical outcomes. We also evaluated and proposed plausible biochemical and physiological mechanisms for vitamin D and CVD. We graded the evidence according to BHC for the establishment of causality in biological systems and the identification of strengths and pitfalls of this approach. The search yielded 4170 papers, and 31 met the predefined criteria. The criteria “strength of association”, “consistency”, “temporality”, “biological gradient”, “plausibility”, “experiment”, “specificity”, “analogy”, and “coherence” were analyzed and appraised. While the logical framework of the BHC is perceived as useful, its direct applicability to the nutritional context is partly open to interpretation and could be further specified. The Bradford Hill criteria for establishing causality need adaptation for the nutritional context and to the advances in biological and social sciences in the last decades. Insights gained and methodological paradigms identified may have broad application to nutrition science.

Keywords: Nutritional Science; Vitamin D; Cardiovascular Disease; Bradford Hill criteria

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Evaluating Affordability of Healthier Diets in Four African Countries [†]

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Marinel Hoffman ⁵, Abdelrahman Lubowa ⁶, Gaston Ampe Tumuhimbise ⁷, Mikael Fogelholm ³ and Natalia Rosa-Sibakov ⁸



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Abstract: Between 702 and 828 million people around the world were affected by hunger in 2021.

The prevalence of undernourishment relentlessly continues to affect the world, and particularly SubSaharan Africa (23.2% in 2021). Exacerbated inequalities across and within countries are undermining the nutritional adequacy and affordability of diets and threatening vulnerable groups including children under five years of age and women of reproductive age. This research presents a diet optimization approach where the objective is to evaluate the nutritional adequacy and affordability of diets across 4 African countries, namely Ethiopia, Kenya, South Africa and Uganda. The targeted population includes dyads of women of reproductive age and their children between 6 and 24 months. The mathematical programming approach allows for the theoretically contrasting of optimal outcomes of the model with data from food consumption surveys in primary and secondary cities of each country. Based on the observed food intake patterns and the nutrient deficiencies, these outcomes propose new diets modifying food intake (organized in food groups) in order to achieve nutritional adequacy while minimizing food intake changes, or, if applicable, the outcomes indicate which nutrient recommendations are unattainable under the current model setup. On average, our results show that nutritional adequacy can be attained by increasing the intake of legumes, vegetables and fruits, while reducing the intake of cereals. We include a discussion on the assessment of diet affordability and show the practical implications of evaluating healthier diets' viability. Conclusions include paths for future research on diet optimization modelling and its implications as a means of support for designing future dietary guidelines.

Keywords: diet optimization; mathematical programming; health and welfare; diet affordability

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New Standards for Nutrition Science, Concepts and Methods—Low Socioeconomic Status and Overweight: Participatory Research Designs for the Development of Interventions [†]

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Citation: van Zutphen, T.; Gaudichon, C.; Morze, J.; Poulia, L.; Da Silva, G.R.; Marcos, A.; Haisma, H. New Standards for Nutrition Science, Concepts and Methods—Low Socioeconomic Status and Overweight: Participatory Research Designs for the Development of Interventions. *Proceedings* **2023**, *91*, 125. <https://doi.org/10.3390/proceedings2023091125>

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Keywords: low socioeconomic status; participatory approach; community; overweight; intervention

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Background: The heavy burden of obesity on individuals and society has attracted a lot of attention, and many strategies to prevent or reverse it have been developed. Consequently, many reviews exist on this topic. However, similar to the bulk of studies, most reviews on combatting obesity follow the traditional (bio)medical approach. Dedicated interventions that take the unequal distribution of obesity among socioeconomic groups into account, particularly by applying an interdisciplinary approach that includes participation of the most heavily burdened low-SES groups themselves, are much more scarce and thus also less frequently reviewed. **Objective:** We aim to write a scoping review on interventions or initiatives aiming at obesity among groups with low socioeconomic status that apply a form of participation of the target group. We will focus on community-based programmes. **Methods:** We performed a literature search in Scopus, Web of Science and Pubmed. Using Rayyan software [1], we identified 3227 articles, of which, after screening the abstracts and full texts, 16 were eligible for further extraction of data. **Results:** Currently, we are at the stage of data extraction. Preliminary findings show that participatory approaches have an effect on a range of outcomes in low-SES populations, including dietary patterns, sleep and/or BMI. **Discussion:** By confining the review to community-based participatory research, identifying causal relationships is not our main goal. Nevertheless, we will focus on interventions, initiatives or programmes that aim to generate an impact and therefore go beyond associations or identifications of underlying determinants. Instead, it may give us an understanding of why we tend to be ineffective in combatting obesity in low-SES populations with top-down approaches and possibly identify strategies that do have a long-term impact. At the conference, we will be able to present the final data and conclusions.

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Adherence to French Dietary Guidelines Is Associated with a Reduced Risk of All-Cause, Cardiovascular Diseases and All, Breast and Lung Cancer Mortality in the E3N COHORT [†]

Chloé Marques ^{*} , Pauline Frenoy, Nasser Laouali , Sanam Shah, Gianluca Severi and Francesca Romana Mancini



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Diet is a modifiable risk factor of non-communicable diseases. The French dietary guidelines, updated in 2017, provide recommendations for a healthier diet. We aimed to study the association between adherence to these dietary guidelines and mortality in the E3N (Etude Epidémiologique auprès de femmes de l'Education Nationale) French cohort. Methods: We studied 72,585 women included in the E3N prospective cohort, which completed a food frequency questionnaire in 1993. Adherence to French dietary guidelines was estimated using the simplified “Programme National Nutrition Santé—guidelines score 2” (sPNNS-GS2, range: −20.4 to 12.6). We estimated the association between sPNNS-GS2 and all-cause or cause-specific mortality using Cox proportional hazard models, adjusted for age (as time-scale), BMI, physical activity, birth generation, education level, smoking status, menopausal status and recent menopausal hormone therapy use, and total energy intake. Results: During follow-up (1993–2014), we identified 6441 deaths. The mean sPNNS-GS2 was 3.8 (SD 3.0). In the fully adjusted model, we found a non-linear inverse association, with a plateau from the third quartile, between sPNNS-GS2 and all-cause (HRQ4 vs. Q1 [95%CI]: 0.79 [0.73; 0.86]), all cancers (HRQ4 vs. Q1 [95%CI]: 0.79 [0.70; 0.89]) and breast cancer (HRQ4 vs. Q1 [95%CI]: 0.73 [0.58; 0.91]) mortality. We also highlighted a non-linear U-shaped association with lung cancer mortality (HRQ3 vs. Q1 [95%CI]: 0.62 [0.45; 0.87] and HRQ4 vs. Q1 [95%CI]: 0.73 [0.52; 1.02]) and a linear inverse association with cardiovascular disease mortality (HRoneSTD [95%CI]: 0.86 [0.76; 0.97]). We observed no association with colorectal cancer mortality (HRoneSTD [95%CI]: 0.86 [0.70; 1.04]). Discussion: This study on a large prospective cohort following more than 70,000 women for over 20 years suggests that a higher adherence to the French dietary guidelines is associated with a reduced risk of mortality from all-cause cardiovascular diseases, all cancers, breast cancer and lung cancer. These results enable us to confirm the French nutritional recommendations. Finally, the reduced risk observed for various mortality outcomes is an important public health message.

Keywords: diet; guidelines; mortality; cohort

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Abstract

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Abstract

Exploring the Impact of Basal Metabolic Rate Equations on Goldberg Cut-Offs: Influence on Estimated Usual Energy Intake in the Elderly [†]

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Keywords: dietary intake misreporting; predictive equations; basal metabolic rate; Goldberg cut-offs

intake (DI) in the elderly can be difficult, and its reliability can be affected by several factors, including misreporting, which is one of the major sources of error regardless of the method used. The Goldberg cut-off is commonly used to identify misreporting of DI and includes the ratio of the individuals' reported energy intake (EI) to their estimated basal metabolic rate (BMR), which is then compared to pre-defined cut-offs. BMR can be estimated by applying different equations, considering anthropometric factors or lean body mass (LBM). The literature reports that the use of BMR equations which include LBM are among the most accurate. We aimed to show how applying different BMR equations can affect the parameters in the Goldberg method and further influence the usual EI. The study population was 318 elderly people aged 65–101 years living in different Slovenian nursing homes, who were relatively independent and able to feed themselves, who reported 24 h dietary recall for two non-consecutive days and completed a food frequency questionnaire, and who had an LBM measured with bioelectrical impedance. The usual EI was determined using the Multiple Source Method. A physical activity level (PAL) of 1.2 and 1.5 was applied, based on the expected PAL of participants. A post hoc ANOVA mean difference test using Bonferroni correction showed that differences existed in the mean EI:BMR calculated using different equations. The result of the Harris–Benedict equation, revised by Roza and Shizgal (1984) [1], was significantly different compared to equations which use LBM, while Mifflin et al. (1990) [2] and Porter et al. (2023)'s [3] anthropometric equations showed no significant differences. There were no significant differences between the estimated usual EI calculated based on different equations used in Goldberg cut-offs. The appropriate PAL according to the activity of the study population should be carefully considered, as it might influence the identification of misreporting. Differences were observed in the amount of misreporting between different equations used in the Goldberg cut-off method. Kappa statistics showed that Mifflin et al. (1990)'s [2] equation using anthropometric data had the best agreement with equations that use LBM. We showed that the use of different BMR equations does not impact the estimation of mean usual EI using Goldberg cut-offs; however, it might influence the quartile distribution and subjects' characteristics.

Author Contributions: Ž.L. participated in conducting the study, wrote the abstract and prepared for submission. I.P. participated in conducting the study, reviewing, and editing. H.H. prepared the data, carried out the data analyses, and supported the co-conceptualization and writing the abstract. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki. Nutricare study was approved by the National Medical Ethics Committee, Ljubljana, Slovenia (approval number: KME 0120-531/2021/13). Study was registered at ClinicalTrials.gov (ID: NCT03284840). NCT05389618.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: All participants were fully informed why the research is being conducted and how their data will be used, and consented into study participation, knowing about the ability to withdraw from the study at any time. No risks were identified for study participants. The data presented in this study are available upon request from the corresponding author.

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New Standards for Nutrition Science, Concepts and Methods—Novel Approach to Substantiate Cause- and -Effect Relationships in Nutritional Science by Ranking Studies and Subsequent Statistical Modelling [†]

Wim Calame ^{1,*} , Isabel Slurink ² and Andrea Budelli ³



Citation: Calame, W.; Slurink, I.; Budelli, A. New Standards for Nutrition Science, Concepts and Methods—Novel Approach to Substantiate Cause- and -Effect Relationships in Nutritional Science by Ranking Studies and Subsequent Statistical Modelling. *Proceedings* **2023**, *91*, 96. <https://doi.org/10.3390/proceedings2023091096>

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Keywords: cause-and-effect; Bradford Hill criteria; hierarchy of evidence; statistical validation

In any scientific field, demonstrating cause-and-effect relationships is of the utmost importance, however difficult to achieve. The present study aims to establish an objective approach to substantiate cause-and-effect relationships. Our approach consisted of ranking published studies and subsequently using the best performing studies to construct and validate a statistical model. For the first part, studies on the association between vitamin D status and COVID-19 severity (morbidity/mortality) in hospitalized patients were identified and ranked using a combination of physiological and statistical relevance, including dose-dependency, power evaluation, confounding, physiological mechanisms, and target population. The various ranking criteria were developed in an iterative process, taking into account the Bradford Hill criteria. For the second part, a two-step statistical modelling strategy was implemented. Firstly, a multivariate model was constructed and secondly, this model was validated using data from at least one other independent study with a similar design. The sensitivity (percentage of correctly detected cases by the model) and specificity (percentage of correctly detected non-cases by the model) was assessed in both studies, and the results of both studies (model-making and model-testing) were compared using the Chi-square test with expectation. Five ranking criteria were defined with a maximum score of 67 points. Six studies were selected with scores ranging between 27 and 47 points [1–6]. The highest score was obtained by Hernandez et al., 2021 [1]. Unfortunately, it was not possible to obtain complete independent datasets of these studies. Therefore, to evaluate our approach in cause- and -effect relationships, two datasets were selected of studies on the effects of postbiotic intake on the incidence of pulmonary and gastrointestinal infections in children aged 1 to 4 years [7,8]. A logistic confounding model in combination with a discriminant analysis was applied on the first (model-making) study resulting in an internal sensitivity and specificity of 78% and 100%,

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respectively ($p < 0.001$), showing a treatment effect on the reduction of infections ($p < 0.001$). An external validation of the acquired

model in a second independent (model-testing) study showed sensitivity and specificity of 76% and 80% ($p < 0.001$), again showing a treatment effect ($p < 0.001$). The sensitivity and specificity were not statistically different indicating similarity of the impact by the explanatory variables in both datasets. Overall, the combination of ranking studies and statistical modelling supports the validation of cause-and-effect relationships using

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objective criteria. Demonstrating consistency in associations by replication and robustness testing contributes to proof of concept in causative relations.

Author Contributions: Conceptualization, W.C. and I.S.; methodology, W.C. and I.S.; formal analysis, W.C. and I.S., resources, A.B. and W.C.; writing—original draft preparation, W.C. and I.S.; writing—review and editing, all authors. All authors have read and agreed to the published version of the manuscript.

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Philosophical Reflection on Holism and Reductionism in Nutrition Science [†]

Eline Baltussen ^{1,*} and Marcel Verweij ²



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Abstract: Nutrition, as a science, is facing challenges. While issues regarding obesity, chronic diseases, and sustainability are becoming more pressing, nutrition science is encountering limitations regarding novel insights, trust, and social relevance. In order to move forward, we need to innovate the field and explore new perspectives. Current nutrition research has mainly employed a reductionist approach, which has been very successful in the past. However, reductionism shows limitations when addressing the problems we face today. The addressed weaknesses of reductionism include (1) the questionable assumption that nutrients and calories are exchangeable between foods, (2) the tendency of reductionism to oversimplify reality, which has consequences for complex concepts such as health and nutrition, and (3) the focus on details, which could undermine the aim of nutrition science: creating optimal dietary guidelines for the promotion of health and prevention of disease. Holism offers an alternative perspective that could complement these limitations, on the condition that they are similar enough on an ontological and epistemological level. Holistic approaches to health appear in eastern philosophies (ayurveda), but also in modern western nutrition approaches (dietary patterns). These two holistic approaches can complement reductionism in the following ways: (1) Holistic approaches like ayurveda and dietary patterns provide different nutritional knowledge by considering multiple factors that affect food's health potential, in addition to only nutrients and calories. Some of these factors include food processing, food matrix/structure, food combinations, food compatibility, and nutrient interaction. (2) Holism can complement the reductionistic tendency to oversimplify reality by including subjective, individual, and holistic aspects of health into nutrition research and embracing the complexity of food-chronic disease relationships. (3) Holism has the potential to improve the practical relevance and comprehensibility of nutrition science. All presented results were based on the existing literature, found in Scopus and PubMed. To conclude, this study explores how holism can complement the limitations of reductionism, and as a result, reduce the overemphasis on reductionism as a research approach, which will hopefully promote progress and inspire the future of nutrition science.

Keywords: nutrition; nutrition science; holism; reductionism; ayurveda; dietary patterns

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Development of a Diet Quality Score and Adherence to the Swiss Dietary Recommendations for Vegans[†]

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Abstract: Background: Vegan diets have recently gained popularity in Switzerland and abroad. A method to evaluate the diet quality of the vegan population for research and clinical practice is currently not available. Therefore, the aim of the present study was to develop a diet quality score for vegans (DQS-V) based on the Swiss dietary recommendations for vegans. Methods: The dataset included 52 healthy vegan adults. Dietary intake data were assessed using three-day weighed food records. Body weight and height were measured, and a venous blood sample for the analysis of vitamin and mineral status was collected. Spearman rank correlation coefficients were used due to the presence of not-normally distributed data. Dietary patterns were identified using principal component analysis (PCA). Results: The DQS-V score (mean \pm SD) was 48.9 ± 14.7 . Most vegans adhered to the recommended portions of vegetables, vitamin C-rich vegetables, fruits, omega 3-rich nuts, fats and oils, and iodised salt. However, the intake of green leafy vegetables, vitamin C-rich fruits, wholegrains, legumes, nuts and seeds, selenium-rich nuts, zero caloric liquid, and calcium-fortified foods was suboptimal. The intake of sweet-, salty-, fried foods and alcohol was higher than recommended. The DQS-V had a significantly positive correlation with intakes of fibre, polyunsaturated fatty acids, potassium, zinc, and phosphorus (p 's < 0.05) but was negatively correlated with vitamin B12 and niacin intakes (p 's < 0.05). Two dietary patterns were derived from PCA: (1) refined grains and sweets and (2) wholegrains and nuts. The correlation between the DQS-V and the first dietary pattern was negative (-0.41 , $p = 0.004$), but positive for the second dietary pattern (0.37 , $p = 0.01$). The dietary pattern of refined grains and sweets was inversely correlated with the beta-carotene status (-0.41 , $p = 0.004$) and the vitamin C status ($r = -0.51$, $p = 0.0002$). Conclusion: The newly developed DQS-V, based on the Swiss dietary recommendations for vegans, provides a single score for estimating the diet quality among vegan adults. Further validation studies examining the correlation of DQS-V with an independent dietary assessment method and with the biomarkers of nutritional intake and status are still needed before the general use of the DQS-V score.

Keywords: diet quality score; diet index; dietary patterns; vegan diet; vegan recommendations; vegan dietary guidelines

Author Contributions: Study concept and design: L.H.B., N.B., K.V.D.H. and I.H.-A.; study execution: N.B., L.H.B. and G.T.; data analysis: N.B., L.H.B. and J.H.; first manuscript draft: N.B., J.H. and L.H.B.; funding acquisition: L.H.B. and I.H.-A.; All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data are available from the authors upon reasonable request.

Conflicts of Interest: The authors declare no conflict of interest.



Abstract

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Abstract

Assessment of the Effects of Updated Nutri-Score Nutrient Profiling Algorithm Using a Representative Slovenian Food Supply Dataset [†]

Edvina Hafner ^{1,2}  and Igor Pravst ^{1,2,3,*} 



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relevant option for this harmonisation is Nutri-Score (NS), which, however, has been subject to some criticism about its alignment with nutritional recommendations. As a result, the Scientific Committee of the NS published two reports in 2022 and 2023, updating the NS algorithm. The aim of our study was to exploit differences between previous (NS2021) and updated (NS2023) algorithm, using foods from Slovenian food supply. Methods: A total of 19,510 branded foods/drinks from the 2020 Slovenian food supply database were profiled using NS2021 and NS2023. We focused on comparing the distribution of each grade and the discriminatory ability between NS2021 and NS2023, while identifying products that were most affected by the NS2023 changes. We also examined changes in alignment with Slovenian nutritional recommendations based on nationally adapted WHO Europe nutrient profile (WHOE). Results: The results show that both NS2021 and NS2023 have good discriminatory ability, with NS2023 being slightly better in 12 sub-categories. Overall, NS2023 was stricter, with E being the most common grade (32%), whereas NS2021 predominantly assigned a grade of D (28%). While the overall proportion of products with grade C remained almost unaffected, there was a notable decrease in “healthier” products graded A or B, from 30% (NS2021) to 23% (NS2023). NS2023 was stricter than NS2021 in almost all main categories, except for beverages and eggs. Alignment with the WHOE profile was moderate ($\kappa = 0.59$) for NS2021 and strong ($\kappa = 0.65$) for NS2023. Alignment was improved especially for edible oils and emulsions, fruits and vegetables, and snack foods. Discussion: NS2023 was shown to be stricter and more aligned with recommendations than NS2021. The updated

NS2023 addressed limitations such as better grading of cooking oils (especially olive oil), higher penalisation of high sugar and salt content, lower grading of beverages with non-nutritive sweeteners, and slight modifications for nuts and cheeses. This study gives first insights into how the update of the NS algorithm works on real-life data and can support policymakers in the implementation of harmonised FOPNL in Europe.

Keywords: Nutri-Score; nutrient profiling; front-of-package labelling; food supply; food policy

Abstract: Background: Front-of-package nutrition labelling (FOPNL) is an important public health tool for promoting healthier food choices. Therefore, the European Commission has committed to proposing harmonised mandatory FOPNL in Europe. A

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project (FNS-Cloud), which has received funding from the European Union’s Horizon 2020 Research and Innovation programme (H2020-EU.3.2.2.3.—A Sustainable and Competitive Agri-Food Industry) under Grant Agreement No. 863059. The information and views in this report do not necessarily reflect the official opinion or position of the European Union. Neither European Union institutions and bodies nor any person acting on their behalf may be held responsible for any use that may be made of the information contained herein.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors without undue reservation (without disclosure of specific food brands or other identifiers). Requests to access the datasets should be directed to Igor Pravst (igor.pravst@nutris.org).

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results. I.P. has led and participated in various other research projects in the area of nutrition, public health, and food technology, which were (co)funded by the Slovenian Research Agency, the Ministry of Health of the Republic of Slovenia, the Ministry of Agriculture, Forestry and Food of the Republic of



Slovenia, and in the case of specific applied research projects, also by food businesses. While he has not been involved in the development or implementation of NS, he was involved in independent studies that assessed NS, and disclosed his support for the implementation of mandatory harmonised FOPNL in the EU.

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A Cross-Sectional Study on Micronutrient Adequacy and Associated Factors among School-Going Adolescent Girls [†]

Priyanka Pareek ^{*}, Aparna Thorat and Chethana Chandrasekar



Citation: Pareek, P.; Thorat, A.; Chandrasekar, C. A Cross-Sectional Study on Micronutrient Adequacy and Associated Factors among School-Going Adolescent Girls.

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Abstract: Background: Micronutrient deficiency is also referred as hidden hunger, and it

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increases the global disease burden. Adolescent girls need nutritional care, and their poor dietary intake leads to micronutrient deficiency and poor maternal outcomes. Therefore, there is an urgent need to assess the micronutrient intake among adolescent girls to plan and promote healthy eating behavior and break the malicious cycle of intergenerational malnutrition. Objective: To assess the micronutrient adequacy and associated factors among school-going adolescent girls. Methodology: A school-based, cross-sectional study was conducted among 300 adolescent girls in the suburban area of Navi Mumbai, Maharashtra, India. A simple random-sampling technique was used to select the study participants. A structured questionnaire was used to assess sociodemographic profiles and other factors. The heights and weights of the participants were measured through a standardized method, and their BMI was calculated. Their dietary intake was assessed by taking 24-h recall for three consecutive days, including the weekend. Nutrient adequacy was assessed as the amount of nutrients per 1000 kcal of the participants' diet that met the critical nutrient density, and it was compared to the observed nutrient densities of the adolescent girls. The data were analyzed using the SPSS software version 24. Independent t, Pearson's correlation, and chi-squared tests were used to assess the difference and association between micronutrient densities and different variables. Results: For most micronutrients (iron, calcium, zinc, vitamin A, vitamin D, thiamin, riboflavin, niacin, folic acid, vitamin B12, and vitamin C) the observed density was less than that recommended, meaning intake was inadequate. The mean densities of vitamin A, vitamin B12, iron, calcium, and potassium were significantly

($p < 0.05$) associated with age, BMI, dietary diversity scores, socioeconomic status, and body image concern. Conclusion: The findings of this study revealed that micronutrient intake inadequacy among adolescent girls is a public health problem in the study area. Therefore, interventions should be planned with a focus on nutrition-sensitive activities to increase diet diversification and nutrition security among adolescent girls.

Keywords: micronutrient adequacy; adolescents girls; nutrient density

Author Contributions: Conceptualization, P.P.; methodology, P.P.; validation, P.P.; formal analysis, P.P.; investigation, P.P., A.T. and C.C.; resources, P.P. and A.T.; data curation, P.P.; writing—original draft preparation, P.P., A.T. and C.C.; writing—review and editing, P.P.; visualization, P.P., A.T. and C.C.; supervision, P.P.; project administration, P.P. All authors have read and agreed to the published version of the manuscript.

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Defining Public Health Nutrition Goals Based on Food Balance Sheets—A Proof-of-Principle [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Food balance sheets (FBSs) provide comprehensive annual information on a country's food supply, reflecting possible trends in a population's overall food consumption. However, FBSs essentially refer to agricultural products and primary commodities, rather than foods ready to be consumed. Therefore, FBSs have only limited value for assessing the nutritional adequacy of a country's food supply. However, certain data transformations could substantially enhance the suitability of FBSs for public health purposes, considering human and planetary health alike. Methods: Schwinglhackl et al. (2019) [1] estimated disability-adjusted life years (DALYs) attributable to the intake of food groups as well as respective theoretical minimum risk exposure levels (TMREs). These data are translated into respective food supply using ratios of FBS data and respective nationally representative food consumption. Poore and Nemecek (2018) [2] provide data on the environmental impact of 43 agricultural products along the complete supply chain, allowing the analysis of various sustainability parameters for specific products or the entire food supply. Results: The inadequate consumption of nuts or fruits has the highest contribution to food-related DALYs (approx. 20% each), followed by fish and soft drinks (approx. 15% each), and legumes, vegetables, meat, or dairy (approx. 8% each). The average consumption of red meat exceeded the respective TMREL by a factor of 2.6, whereas the consumption of most other food products reached the TMREL only by fraction, e.g., fish and legumes: 20%, respectively, nuts: 26%, and vegetables: 49%. Animal products make up more than 75% of the greenhouse gas emissions attributable to the food sector (red meat: 28%, dairy: 30%, butter: 10%, poultry, fish, and eggs together: 8%). The situation is quite similar when considering freshwater use. Discussion: Despite serious methodological limitations of FBS data, they can provide a valuable basis for defining public health nutrition goals. Clearly, human and planetary health would both benefit from a drastic reduction in meat consumption and a sincere endeavor to replace animal products with plants. **Keywords:** food balance sheets; food supply; DALYs; sustainability; public health nutrition



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Introduction of the European Regulatory Framework for New Sweeteners and Sweetness Enhancers and Its Role as a Facilitator or Barrier to Innovation: Results from the SWEET Project [†]

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Abstract: There is a growing consumer interest and public health mandate to reduce sugar intake, and an increased impetus to innovate in the food sector to develop new and more acceptable sweeteners and sweetness enhancers (S&SEs) as low- or non-calorific replacements for sugar. Within the European context, S&SEs are subject to stringent risk assessment and regulatory framework to permit new S&SEs in the European market. There has been a long-standing debate about the role of regulation in facilitating or slowing down innovation processes. The aim of this study is to examine the S&SE regulation and risk governance framework, with a specific focus on the implementation of the precautionary principle to assess its perceived impact on the food industry's ability to innovate. We conducted six semi-structured interviews with food industry applicants for new and novel S&SE approval. The study results indicate that the legislation is achieving its primary aims of harmonising the approval process, ensuring consumer safety, and contributing to the public health policies of the EU. However, there are several barriers to innovation associated with the regulatory framework, including the application of the precautionary principle and the burden-of-proof requirement facing the industry. The barriers are particularly relevant to small and medium organisations who have limited resources to accommodate these uncertainties. An open dialogue between business operatives and risk assessors would be an important step towards raising this awareness and addressing the uncertainties within the process.

Keywords: non-nutritive sweeteners; sugar-reduction; regulation



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Effects of Plant-Origin Superoxide Dismutase Supplementation on Selected Parameters of Inflammation and White Blood Cell Count in Athletes [†]

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Abstract: Background and objectives: Regular moderate exercise is considered a protector against chronic inflammatory diseases. Intense exercise causes a significant release of pro-inflammatory cytokines and free radicals depending on exercise intensity and duration. The aim of this study was to investigate the effects of antioxidant supplementation on parameters of immunity and inflammation in athletes. Methods: The study included 14 elite rowers (group 1) and 10 recreational athletes (group 2). All participants were supplemented with 500 mg/day (500 IU SOD) plant-origin superoxide dismutase (Glisodin[®]) during a 6-week pre-competition microcycle preparation period (rowers, 120 min training/6 days weekly; recreational athletes, 60 minutes training/3 days weekly). Venous blood samples were taken in the morning after a 24-hour resting period. White blood cell (WBC) and its subpopulation count were determined using an Act Diff Hematology Analyzer (Beckman Coulter, Inc., Brea, CA, USA) and CRP concentration using the biochemistry analyzer Olympus

AU400 (Beckman Coulter, Inc., Brea, CA, USA) at the Faculty of Pharmacy, University of Belgrade. Selected cytokines IL-4, IL-6, IL-8, and IL-10 were measured by hs ELISA kits (R&D Systems). All data were analyzed using nonparametric tests (Mann–Whitney U test, Kruskal–Wallis test). Results: WBCs and their subpopulation were all in the reference range in both groups before and after supplementation, without significant differences within and between groups according to tests considering supplementation. In rowers, IL-6 was significantly higher before and after supplementation ($p < 0.001$, $p < 0.001$ respectively), CRP was higher before supplementation ($p = 0.025$), and IL-10 was higher at initial and final testing ($p = 0.030$, $p = 0.040$ respectively). In the recreational group, IL-8 and IL-4 were higher at both measuring points ($p < 0.001$ and $p < 0.01$ respectively). Observing changes in variables within the groups, there was a significantly decreased level of IL-6 ($p = 0.019$) and increased level of IL-4 ($p = 0.001$) in rowers and a higher IL-4 level in the recreational group ($p = 0.059$) after supplementation. Discussion: The results of this investigation indicate that there are positive effects of Glisodin supplementation on parameters of inflammation (decreased IL-6, increased IL-4), especially in highly trained rowers, who are more prone to exercise-related oxidative stress. More studies including a greater number of participants are necessary to confirm the influence of antioxidant supplementation on immunity and inflammation in athletes.

Keywords: athletes; Glisodin; supplementation; inflammation



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Adherence to the Mediterranean Diet and the Consumption of Its Food Groups in a Sample of over 10,000 Italian Adults [†]

Sofia Lotti * , Monica Dinu , Giuditta Pagliai, Marta Tristan Asensi , Antonia Napoletano, Barbara Colombini and Francesco Sofi



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Abstract: Adherence to the Mediterranean diet (MD) has been shown to promote health and reduce the prevalence of several chronic diseases. However, to date, more and more countries in the Mediterranean basin seem to be moving away from their traditional eating habits, including Italy. Therefore, the aim of this study was to investigate adherence to the MD and the consumption of its food groups in a large sample of Italian adults. After the removal of duplicates, the study sample comprised 10,916 questionnaires, of which 7088 were completed by women (65%) and 3828 by men (35%). The dietary intake of each food group component in the questionnaire was estimated by multiplying the frequency by the portion size. The mean Medi-Lite score was 12 ± 2.5 , suggesting a moderate level of MD adherence, with a significantly ($p < 0.05$) higher level of adherence observed in women and older subjects. The analysis of the consumption of the individual food groups showed a consumption behavior in line with the national dietary recommendations of fruit (342 g/day), pasta (96 g/day), white meat (302 g/week) and fish (296 g/week). On the other hand, a low consumption of vegetables (270 g/day), bread (85 g/day), legumes (233 g/week) and milk and dairy products (187 g/day) emerged. In addition, the consumption of red meat (209 g/week) was observed to be twice as high as the national guidelines. Subgroup analysis showed that women and the elderly consumed significantly ($p < 0.001$) more fruit, vegetables, and bread and less meat and meat products than did men and younger subjects. Upon a logistic regression analysis adjusted for possible confounding factors, women showed an increased probability (OR 1.34, 95%CI 1.22–1.46; $p < 0.001$) of being in the highest MD adherence tertile (i.e., Medi-Lite score > 11). Although the sample reported moderate adherence to MD, the consumption of some typically Mediterranean food groups such as vegetables, legumes and bread is still low, while the consumption of red meat is high.

Keywords: Mediterranean diet; Medi-Lite; dietary habits; dietary guidelines; food consumption

Author Contributions: Conceptualization: S.L., M.D., F.S.; Analysis and interpretation of the data: S.L., A.N., M.T.A., M.D., F.S.; Drafting of the article: S.L., G.P., B.C., F.S.; Critical revision of the article for important intellectual content: A.N., M.T.A., G.P.; Final approval of the article: G.P., B.C., M.D., F.S.; Statistical expertise: M.D. All authors have read and agreed to the published version of the manuscript.

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Weight Loss Effect of an App-Based Multimodal Lifestyle Intervention in Adults with Obesity—A Randomized Controlled Trial[†]

Kathrin Gemesi^{1,*}, Stefanie Winkler¹, Florian Schederecker², Hans Hauner^{1,3} and Christina Holzapfel^{1,4}



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Weight Loss Effect of an App-Based Multimodal Lifestyle Intervention in Adults with

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Abstract: Quality-proven Digital Health Applications (DiGAs) or “apps on prescription” in Germany extend obesity treatment options. This 24-week single-center randomized controlled trial aimed to examine the weight-lowering effect of an evidence-based multimodal weight loss intervention program delivered by a DiGA. **Methods:** Adults with a body mass index (BMI) between 30.0 and 40.0 kg/m² were randomized. In the first 12 weeks, participants either received the app (ADHOC group) or were asked to maintain their current lifestyle (EXPECT group). In the second 12 weeks, the ADHOC group were invited to continue app use and the EXPECT group started with the app intervention. At three visits (baseline, after 12, and 24 weeks), anthropometric variables were measured and quality of life, app usage, and user acceptance were collected by questionnaires (Euroquol, Technology Acceptance Model 3, System Usability Scale). A total of 168 participants (age: 46.8 ± 11.0 years, BMI: 34.2 ± 2.8 kg/m², 64.3% women) were included. The total adherence rates were 82.7% after 12 weeks and 67.3% after 24 weeks. After 12 weeks, the ADHOC group showed a mean weight loss of 3.2 ± 3.0% and the EXPECT group a mean weight loss of 0.3 ± 2.6% with a statistically significant difference between the groups ($p < 0.001$, completers analysis). At the 12-week follow-up, the ADHOC group maintained body weight (weight loss after 24 weeks: 3.1 ± 4.5%, completers analysis), whereas the EXPECT group—starting with the app intervention—lost weight. The investigated multimodal intervention program delivered by a DiGA resulted in a significant and clinically meaningful short-term weight loss with weight maintenance for a further three months.

Keywords: digital; e-Health; weight management

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Author Contributions: Study protocol design, C.H. and H.H.; conducting study visits, K.G., S.W., and C.H.; data management and statistical analysis, K.G.; support of statistical analysis, F.S.; data interpretation, K.G., F.S., H.H. and C.H.; writing, K.G. All authors contributed to the manuscript and approved the submitted version. All authors have read and agreed to the published version of the manuscript.

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starting the trial. The study is registered in the German Register of Clinical Studies (Registration number: DRKS00025291).

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.



Conflicts of Interest: K.G., S.W. and F.S. declare no conflict of interest. H.H. is a member of the scientific advisory board of Oviva AG (Zurich, Switzerland) and C.H. of 4sigma GmbH (Oberhaching, Germany). H.H. and C.H. received speaker honoraries from Novo Nordisk (Copenhagen, Denmark).

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Nutritional and Anthropometric Status of Serbian Adults 10–74 Years Old: Results from European Food Safety Authority (EFSA) EU Menu Food Consumption Survey 2017–2021 [†]

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Abstract: The Serbian National Food Consumption Survey on adults from 10 to 74 years old, including pregnant women and vegetarians, was conducted in compliance with the EFSA EU Menu project support and guidance from 2017 to 2022. Valid data were collected from a total of 3018 participants with 856 adolescents aged 10 to 17 years, 1155 adults aged 18 to 64, 581 elderly subjects aged 65 to 74 years, 145 pregnant women, and 281 persons following a vegetarian diet. Data collection was conducted using a national Survey Pack designed for the project, including the following: a general questionnaire, an age-appropriate Food Propensity Questionnaire, an International Physical Activity Questionnaire, and 24 h dietary recall. The advanced nutritional platform Diet Assess and Plan (DAP) was applied for data storage, processing, and the creation of the final dataset for transfer to EFSA. The Serbian food composition database was used and updated during the project as a resource of food information for all foods and recipes that were consumed by the study cohort. Regardless of age and gender category, the majority (56%) of adults had normal weight according to the Body Mass Index, while 21% were overweight, and 15.5% were underweight. The average daily energy intake was 2178.72 kcal, while overall contributions of carbohydrates, protein, and fat to the total energy intake were 43.37%, 15.47%, and 41.16%, respectively. The proportions of macronutrient intake deviated from the dietary reference values, particularly for fat, which was often too high, where sunflower oil was the major source of fat in diets. Out of the 3018 participants, 98% had breakfast, 99% had lunch, and 95% had dinner, while approx. 80% had snacks between main meals. The highest energy intake was recorded during lunch, 706.5 kcal (32% TE). The survey results provide valuable insight into the nutritional status and dietary habits of adults from 10 to 74 years old living in Serbia. The Serbian food consumption database serves as an evidence platform for decision-making processes in public health nutrition policies and strategies, diet monitoring, exposure risk assessments, and interventions targeting identified nutritional challenges in particular population groups. Harmonized data are part of the EFSA comprehensive food consumption database.

Keywords: food consumption; dietary assessment; nutritional status; body mass index; EFSA EU Menu



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Institutional Review Board Statement: The study was conducted in accordance with the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Institute for Medical Research Ethics Committee in Serbia on 8 December 2017 (EO 123/2017).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Results attained in this study are included in the manuscript. Individual data are not available due to official legal, organizational and data security policies, and ethical restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

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Multi-Faceted Nutritional Science Demonstrated through the Prism of Sugar—A Scoping Review on Sugar Intake Associated with Quality of Life in Children and Adolescents [†]

Stefania Noerman ^{1,*} , Ute Nöthlings ² , Danijela Ristic-Medic ³, Bryndís Eva Birgisdóttir ⁴ , Inge Tetens ⁵ and Marjukka Kolehmainen ⁶



Citation: Noerman, S.; Nöthlings, U.; Ristic-Medic, D.; Birgisdóttir, B.E.; Tetens, I.; Kolehmainen, M.

Multi-Faceted Nutritional Science Demonstrated through the Prism of Sugar—A Scoping Review on Sugar Intake Associated with Quality of Life in Children and Adolescents.

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Abstract: Given our current knowledge and insights into the nature of nutrition, a simplistic approach to understanding the role of nutrition in relation to health outcomes appears insufficient as a scientific base for setting nutrition policies. To raise this issue, we performed a scoping review to evaluate the relationship between sugar intake, quality of life (QoL), and well-being in children and adolescents. Sugar was selected as it is an essential part of many different foods and dietary patterns. Its consumption is motivated by various aspects, such as social relationships, economic status, individual habits, and taste preferences. Childhood and adolescence are important periods in the life span influencing individual dietary habits and taste preferences but have been overlooked. We developed a framework and performed a structured literature search for articles published in English between 2001 and 2023 in three databases (Pubmed, Scopus, and Web of Science). This search resulted in 21 full-text eligible papers with highly heterogeneous exposure and outcome measures. Most studies found a negative association between the intake of sugar, sugar-sweetened beverages, or sweets, and various QoL outcomes, including food insecurity, sleep and sleep-related outcomes, and (oral) health-related QoL. This scoping review showed that the inclusion of more varied endpoints than only non-communicable diseases or caries could add more dimensions to the evidence underlying the association between sugar and health. The application of interdisciplinary approaches considering more aspects of sugar intake could give a more holistic view of nutrition when considering dietary recommendations or developing dietary policies, especially for children.

Keywords: nutrition; methodology; quality of life; dietary guidelines; well-being

Author Contributions: Conceptualization and methodology, all authors; literature search, title screening, S.N.; abstract and full-text screening, U.N., D.R.-M., B.E.B., I.T. and M.K.; writing—original draft preparation and visualization, S.N.; writing—review and editing, U.N., D.R.-M., B.E.B., I.T. and M.K. All authors have read and agreed to the published version of the manuscript.

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Changes in Eating Habits and Contributing Factors during the COVID-19 Pandemic among Medical Students in the Slovak Republic [†]

Jana Babjakova ^{1,*} , Katarina Mayer Vargova ¹, Sona Wimmerova ² and Lubica Argalasova ¹



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Citation: Babjakova, J.; Vargova, K.M.; Wimmerova, S.; Argalasova, L. Changes in Eating Habits and Contributing Factors during the COVID-19 Pandemic among Medical Students in the Slovak Republic. *Proceedings* **2023**, *91*, 33. <https://doi.org/10.3390/proceedings2023091033>

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Abstract: Due to the outbreak of the new coronavirus disease, many lifestyle alterations occurred. Changes in eating habits and contributing factors during the COVID-19 pandemic were examined.

A cross-sectional anonymous online survey was conducted among students from the Faculty of Medicine, Comenius University in Bratislava, during November–December 2022. The data were statistically analysed using IBM SPSS Statistics, version 25. The study population consisted of 783 students; the mean age was 22.7 ± 2.7 years; 68.1% studied in the Slovak language; 67.0% of respondents were female. Out of these, eating habits did not change for the majority of students in the study sample (53.1%) (Slovaks 52.6% vs. foreigners 54.0%; males 53.0% vs. females 53.1%); consumption of alcoholic beverages did not change compared to pre-pandemic period for 54.3% of students, the rest of students decreased (30.6%) or increased (15.1%) consumption; energy drinks consumption remained unchanged for 69.6% students; coffee intake stayed stable for 48.3%, whereas 43.8% increased their coffee consumption, while 7.8% drank less coffee, without any statistically significant difference between the subgroups. The level of physical activity (frequency, intensity, duration) changed with a significant difference between Slovak and foreign students ($p = 0.038$), more foreign students decreased their level of physical activity compared to Slovaks (42.3% vs. 33.8%). We also recorded body weight changing during the pandemic, with a statistically significant difference between men and women ($p = 0.009$); 14.3% of men vs. 22.9% women decreased, while 34.7% of men and 27.3% of women increased their body weight. The results showed some changes in the dietary habits and other lifestyle factors during the pandemic among medical students. Future healthcare providers will play key roles in health promotion and disease prevention, and they should serve as role models for their patients and the general public as well.

Keywords: medical students; COVID-19; changes; dietary habits

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Author Contributions: Conceptualization, J.B. and L.A.; methodology, J.B.; software, S.W.; validation, J.B., L.A. and S.W.; formal analysis, S.W.; investigation, J.B.; resources, K.M.V.; data curation, S.W.; writing—original draft preparation, J.B.; writing—review and editing, L.A. and S.W.; visualization, K.M.V.; supervision, L.A.; project administration, J.B. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.



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Capacity Development and Harmonization of Food Consumption Data Collection in EFSA EU Menu National Dietary Surveys in Balkan Region-Building: The Evidence Base for Diet Monitoring and Food Systems Transformation [†]

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Abstract: Harmonized and standardized collection, processing, and analysis of individual dietary data is essential for nutrition assessment and informed policy decision making. To underpin the harmonization of food consumption data collection methodologies and the development of a common, comprehensive European food consumption database, the European Food Safety Authority (EFSA) supported 36 child and/or adult dietary surveys in 18 EU Member States and four Balkan preaccession countries through the EU Menu Project. Given the lack of relevant and harmonized research and data on food and nutrition in the Balkan region, CENM-IMR and CAPNUTRA scientists focused their activities on capacity building in nutrition research, particularly on the creation of a contemporary, harmonized research infrastructure (RI) that meets European standards. The EFSA EU Menu methodology has been implemented in the Balkans through the adaptation and use of an innovative, comprehensive tool for the standardized collection of food consumption and dietary intake assessment data, the Diet Assess and Plan (DAP). DAP has the essential features of an RI needed to strengthen public health surveillance, monitoring, evaluation, and nutrition research; this is a unique example of a standardized and harmonized tool for assessing dietary intake, i.e., collecting data on food and nutrition in the Balkan region and beyond. It is a concurrent tool for large-scale nutritional epidemiological studies and represents one of the new technologies for dietary intake assessment. National dietary surveys were conducted from 2017 to 2023 among adults aged 10 to 74 years (in Bosnia and Herzegovina, Montenegro, and Serbia) and children aged three months to nine years (in Montenegro, North Macedonia, and Serbia). The collected data on food consumption are internationally comparable with other European countries under the EU Menu Program. The data collected will be used for dietary and exposure risk assessment, establishment of national nutrient reference values, as a basis for the development of food-based dietary guidelines, a tool to provide evidence and infrastructure for public health nutrition policy decisions, and for tailored pathways to transform the food system in the Balkans towards a more nutrition-sensitive and sustainable system.



Citation: Gurinovic, M.; Milešević, J.; Zekovic, M.; Knez, M.; Takic, M.; Šarac, I.; Kadvan, A. Capacity Development and Harmonization of Food Consumption Data Collection in EFSA EU Menu National Dietary Surveys in Balkan Region-Building: The Evidence Base for Diet Monitoring and Food Systems Transformation. *Proceedings* **2023**, *91*, 24. <https://doi.org/10.3390/proceedings2023091024>

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Keywords: capacity development; food consumption; EU Menu; harmonization

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Data Availability Statement: Results attained in this study are included in the manuscript. Individual data are not available due to official legal, organizational and data security policies, and ethical restrictions.

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Is Thinness Associated with Poorer Diet and Nutrient Intake and Status in Danish 8–11-Year-Olds? [†]

Anne V. Aurup ^{1,*}, Katrine Strandberg-Larsen ², Rikke Andersen ³, Anja Biloft-Jensen ³ , Lotte Lauritzen ¹ and Camilla T. Damsgaard ¹



Citation: Aurup, A.V.; Strandberg-Larsen, K.; Andersen, R.; Biloft-Jensen, A.; Lauritzen, L.; Damsgaard, C.T. Is Thinness Associated with Poorer Diet and Nutrient Intake and Status in Danish 8–11-Year-Olds? *Proceedings* **2023**, *91*, 64. <https://doi.org/10.3390/proceedings2023091064>

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10%, thinness in children is highly overlooked in high-income countries, and we have little knowledge about the diet and nutrient status among these children. We investigated if dietary intake and biomarkers of nutrient status, including iron, *n*-3 LCPUFA and vitamin D, differed in Danish schoolchildren with thinness compared to children with normal and overweight. We also investigated if intakes of important micronutrients were adequate across weight groups. We used cross-sectional data from 815 Danish 8–11-year-old children collected during the period August–November 2011. Measurements included 7-day dietary records, anthropometry and analysis of nutritional biomarkers in fasting blood samples. We defined thinness using the age- and sex-specific IOTF BMI cut-offs. In total, 10.2% of the children had thinness (boys: 8.9%; girls: 11.6%). These children had lower intake of energy, protein and red meat and higher intake of added sugar compared to children with normal and overweight. Thinness was also associated with higher fish intake compared to overweight, but we found no group differences in whole-blood EPA+DHA. Furthermore, thinness was associated with lower intake of iron and zinc than the other groups and lower intake of selenium versus normal weight, but with no group differences in iron biomarkers, serum ferritin or hemoglobin. The proportions of children with adequate intake of zinc and selenium were lower in the thin (56.5% and 50.7%) compared to the normal-weight children (72.5% and 63.9%) ($p < 0.05$), but the intake of these micronutrients as well as vitamin B12 and calcium were generally high across all weight groups. In contrast, intake of vitamin D and iron were low across groups, and there were no group differences in serum 25(OH)D. Danish children with thinness had different dietary intake than children with normal and overweight, but thin children did not generally have a poorer diet than normal-weight children. We also found comparable nutrient status and intakes of important micronutrients except for iron, zinc and selenium, which were lower in thin children and should be explored further.

Keywords: thinness; underweight; dietary intake; nutrient status

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Author Contributions: The authors' responsibilities were as follows—C.T.D., K.S.-L. and A.V.A. designed the research; C.T.D., L.L. and A.B.-J., R.A. conducted the OPUS study; A.V.A. performed the statistical analyses; A.V.A. wrote the drafts of the paper with help from C.T.D. and K.S.-L.; A.B.-J. developed, validated and prepared the dietary assessment method; A.V.A. has primary responsibility for the final content. All authors have read and agreed to the published version of the manuscript.

Abstract: Thinness is used to denote low BMI in children and may be a marker of undernutrition. However, despite prevalence rates of up to

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Informed Consent Statement: Written informed consent was obtained from the custody holders of all children.

Data Availability Statement: Data described in this abstract will not be made available because data are not anonymized and due to the Danish legislation therefore considered as “personal data”.

Conflicts of Interest: The authors declare no conflict of interest.

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Preface and Statement of Peer Review

Philip C. Calder^{1,2,*} and Sladjana Sobajic^{3,*} 

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17 November 2023 in Belgrade, Serbia. The conference was organized by the Federation of European Nutrition Societies (FENS) and local organizer the Serbian Nutrition Society.

The theme of the 14th European Nutrition Conference is “Food, Nutrition and Health: Translating Science into Practice”. Around this theme, the conference will deliver a highquality programme, featuring international speakers across plenary sessions and scientific symposia. Other features of the programme will be workshops, training sessions, industry symposia, and oral and poster sessions oriented towards early career researchers. This conference will provide opportunities to hear experts and to catch up on the latest science, as well as to become better informed about areas of controversy. The topics of the planned conference symposia are broad and multidisciplinary and will appeal to all those interested in experimental, clinical, and public health nutrition.

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- Emilie Combet, University of Glasgow, Glasgow, UK
- Francesco Sofi, University of Florence, Florence, Italy
- Jadwiga Hamułka, Warsaw University of Life Sciences, Warsaw, Poland

1. Conference Overview

This publication collates the proceedings of the 14th European Nutrition Conference, held from 14 to

- Bryndís Eva Birgisdóttir, University of Iceland, Reykjavik, Iceland
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3. Conference Topics and Number of Sessions for Each Topic

	Symposium Sessions	Oral Sessions	Poster Sessions
Nutrition across the life course	10	5	4
Nutrition, metabolism, and chronic disease	14	8	8
Dietary studies, guidelines, and recommendations	6	5	3
New technologies in nutrition research	4	1	1
Personalised nutrition	4	1	2
Nutrition and the environment, sustainability, and biodiversity	5	4	3
Food science	4	2	3
Dietary bioactives	4	2	2
Nutrition education, consumers, and practitioners	5	1	2
Cultural, societal, and behavioural aspects of diet and nutrition	4	2	3

4. Statement of Peer Review

In submitting conference proceedings to *Proceedings*, the volume editors of the proceedings certify to the publisher that all papers published in this volume have been subjected to peer review overseen by the volume editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal.

- Type of peer review: single-blind
- Conference submission management system: infozonet.in.rs
- Number of submissions sent for review: 741
- Number of submissions accepted: 682
- Acceptance rate (number of submissions accepted/number of submissions received): 0.92
- Average number of reviews per paper: 1
- Total number of reviewers involved: 38
- Description of the process of peer review and/or editorial oversight of all accepted content (e.g., detailed criteria or policy of peer review, etc.): All participants received the result of the review. The types of decisions were as follows: Accept, Resubmit after revision, and Reject.

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Meal Glycemic Load, Meal Frequency, and Alertness: Mediation Effect of Glucose Concentration [†]

Perdana S. T. Suyoto, Mariëlle G. de Rijk, Jeanne H. M. de Vries  and Edith J. M. Feskens * 



Citation: Suyoto, P.S.T.; de Rijk, M.G.; de Vries, J.H.M.; Feskens, E.J.M. Meal Glycemic Load, Meal Frequency, and Alertness: Mediation Effect of Glucose Concentration. *Proceedings* **2023**, *91*, 387. <https://doi.org/10.3390/proceedings2023091387>

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Abstract: Background and objectives: Night shift workers experience circadian disruption that may manifest in poor

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alertness. This study aimed to explain the mediation by acute glucose concentration resulting from the assignment of meals varying in glycemic load (high and low) and meal frequency (1 and 3) on alertness parameters, including the number of lapses, reaction time median (RTMed), and variability (RTVar). Methods: A two-arm randomized cross-over trial was conducted on female nurses working night shifts. In each of the study arms, the 1-MEAL and 3-MEAL arms, the participants followed three intervention periods consisting of the provision of high glycemic load (GL) or low GL meals in the form of yogurts with either dextrose added or the combination of lactose and fructose or fasting (no meal) during three consecutive night shifts with a 2-week washout period. In the 1-MEAL arm, the participants were provided with one meal (1-high GL or 1-low GL), while three meals were provided in the 3-MEAL arm (3-high GL or 3-low GL). Twenty-four-hour interstitial glucose concentrations were measured using continuous glucose monitors during the interventions. The participants performed brief psychomotor vigilance tasks (PVT-B) at 04:00 h. Mediation analysis was performed to determine whether the meal glycemic load effect on the number of lapses, RTMed, and RTVar was explained by the mean glucose concentration 120 min prior to performing the PVT. Result: A mediation effect of mean glucose concentrations on RTVar was observed, for instance, in

1-high GL ($\beta_{ind} = 16.23$ mmol/L, 95%CI: 1.62, 33.89) and 3-high GL ($\beta_{ind} = 8.85$ mmol/L, 95%CI: 0.90, 19.33) compared to no meal. Significant mediation effects of mean glucose concentrations on RTVar were also detected between 3-high vs. 1-high GL, 1-high GL vs. 1-low GL, and 3-high GL vs. 3-low GL. However, no mediation effect was observed on the number of lapses or RTMed.

Discussion: In summary, mediation analysis suggests that an elevated mean glucose concentration 120 min prior to performing the PVT increased the reaction time variability, indicating difficulties in maintaining attention.

Keywords: alertness; glycemic load; meal frequency; glucose; night shift

Author Contributions: Conceptualization, M.G.d.R., J.H.M.d.V. and E.J.M.F.; methodology, M.G.d.R., J.H.M.d.V. and E.J.M.F.; software, P.S.T.S.; formal analysis, P.S.T.S.; investigation, M.G.d.R.; data curation, M.G.d.R.; writing—original draft preparation, P.S.T.S.; writing—review and editing, P.S.T.S., M.G.d.R., J.H.M.d.V. and E.J.M.F.; visualization, P.S.T.S.; funding acquisition, J.H.M.d.V.; All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Effects of a Diabetes-Specific Formula on Glycemic Control and Cardiometabolic Risk Factors in Overweight and Obese Adults with Type 2 Diabetes: Results from a Randomized Controlled Trial [†]

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Abstract: Lifestyle modification, including nutrition therapy, plays an important role in diabetes management. The objective of this randomized controlled trial was to investigate the effects of a diabetes-specific formula (DSF) on glycemic control and cardiometabolic risk factors in individuals with type 2 diabetes. A total of 251 adult men and women with type 2 diabetes on oral antihyperglycemic medication(s) were enrolled, and 235 were randomly assigned to one of two study treatments: (i) DSF with standard of care (DSF group) ($n = 117$) or (ii) standard of care alone (control group) ($n = 118$). The DSF group was asked to consume either one serving of DSF (if baseline BMI ≥ 23.0 and <27.5 kg/m²) or two servings of DSF (if baseline BMI ≥ 27.5 and <35.0 kg/m²) as a meal replacement (MR) or partial MR. Blood biomarkers, anthropometry, body composition, and blood pressure were assessed at baseline, day 45, and day 90. Mean (SE) HbA1c of participants was 7.94 (0.05)% and BMI was 28.37 (0.21) kg/m² at baseline. The DSF group had a significantly greater reduction in HbA1c than the control group at day 45 (-0.44% vs. -0.26% ; $p = 0.015$) and day 90 (-0.50% vs. -0.21% ; $p = 0.002$). Fasting blood glucose was significantly lower in the DSF group at Day 90 (-0.14 mmol/L vs. $+0.32$ mmol/L; $p = 0.036$). The DSF group lost twice as much weight as the control group at day 45 (-1.30 kg vs. -0.61 kg; $p < 0.001$) and day 90 (-1.74 kg vs. -0.76 kg; $p < 0.001$). Waist circumference, hip circumference, fat mass, and visceral adipose tissue were significantly lower in the DSF group compared to the control group (all overall $p \leq 0.004$). The DSF group also had significantly lower diastolic blood pressure (overall $p = 0.045$) and systolic blood pressure at day 90 ($p = 0.043$). This study demonstrated that consuming DSF as a MR or partial MR in addition to the standard of care resulted in significantly greater improvements in glycemic control and cardiometabolic risk factors in overweight and obese adults with type 2 diabetes compared to the standard of care alone.

Keywords: type 2 diabetes; nutrition therapy; meal replacement; diabetes-specific formula; glycemic control; body composition; cardiometabolic risk factors

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Author Contributions: Conceptualization, S.L.T. and D.T.T.H.; methodology, S.L.T., G.B. and D.T.T.H.; formal analysis, Y.B., G.B. and S.L.T.; investigation, W.S.S.C.; data curation, S.L.T.; writing—original draft preparation, S.L.T.; writing—review and editing, S.L.T., W.S.S.C., Y.B., G.B. and D.T.T.H.; visualization, Y.B. and S.L.T.; supervision, S.L.T. and D.T.T.H. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

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Predictors of Reduced Bone Mineral Density in Children and Adolescents with Anorexia Nervosa [†]

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Abstract: The complexity of eating disorders, especially anorexia nervosa (AN), is associated with reduced bone mass (RBM) caused by much more than calorie restriction. The aim of this study was to determine the predictors of reduced bone mass (RBM) in children and adolescents with anorexia nervosa (AN), with the consideration of endotypes. This retrospective study with prospective data collection enrolled 197 hospitalized patients, including 65% with a restrictive type, 25% with a purgative type and 10% with an Eating Disorder Not Otherwise Specified. At the time of hospitalization, the patients already had a noticeable RBM, which did not differ according to their endotype. The age of patients at the time of hospitalization (14.9 ± 2.5 years) was confirmed as an independent risk factor for SKM (41.1% higher risk in older patients). Prevalence of RBM did not differ between the endotypes. However, at the time of hospitalization, the patients already had an RBM, which did not differ by the endotype. Patients' age at hospitalization (14.9 ± 2.5 years) is an independent risk factor for RBM (41.1% higher risk with older age). Body mass at hospitalization directly correlates with bone density ($r = 0.531$; $p < 0.01$) and is another independent risk factor for RBD. The risk drops by 9.6% per each kg of body mass more at hospitalization and by 5.7% per each kg body mass more before the diagnosis. Interestingly, longer nutritional support during hospitalization (per day) independently reduces the risk of RBM by 8.4%. The results confirm RBM, which worsens with AN duration, regardless of the endotype. There is a need for an early diagnosis and adequate physical recovery in order to prevent long-term consequences from fractures to osteoporosis.

Keywords: anorexia nervosa; adolescents; bone mineral density; body mass; nutritional support

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Fatty Acid Profile and Health Lipid Quality Indices of Daily Meals Provided in Kindergartens in Novi Sad, Serbia [†]

Radmila Velicki ^{1,2,*}, Milka Popovic ^{1,2} , Sanja Bijelovic ^{1,2} and Ljilja Torovic ^{2,3}

[†]

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Abstract: Dietary fats, consisting of fatty acids (FAs), have diverse implications for disease prevention and treatment. Understanding the quality of dietary lipids is essential for managing chronic conditions and establishing food-based dietary guidelines. FAs naturally occur as mixtures of saturated (SFAs), monounsaturated (MUFAs), and polyunsaturated FAs (PUFAs), and their nutritional and medicinal values are evaluated using specific indices. This study aimed to assess the FA profiles and lipid quality indices of daily meals served in kindergartens located in Novi Sad, Serbia. During the autumn, winter, and spring seasons of the 2022/2023 year, meal (breakfast, snack, and lunch) sampling was conducted in a randomized manner on 15 unannounced days in each season. The nutritional composition and energy value of the sampled meals were determined, as well as their FA composition (GC-FID). The findings indicated that the average energy value of the daily meals met the recommendations of national regulations, as well as the daily fat intake, with a total fat intake amounting to 24.5 g/day during both the autumn and winter seasons and 23.4 g/day in the spring season. The predominant FAs were SFAs; their average intake was 11.9, 13.4, and 12.1 g/day during autumn, winter, and spring, respectively. MUFA intake exhibited minor variations across the seasons, with mean intakes of 7.8, 7.6, and 7.4 g/day, respectively. The highest mean PUFA intake was observed during autumn (4.8 g/day), while the winter and spring seasons displayed intakes of 3.5 and 4.0 g/day, respectively. Furthermore, regarding the lipid quality indices, the highest average values of PUFAs/SFAs, considered desirable, were identified during autumn (0.51 ± 0.31), whereas the lowest values were observed in winter (0.32 ± 0.27). The atherogenicity (IA) and thrombogenicity (IT) indices consistently exceeded the recommended value of one across all seasons, indicating an unfavorable lipid quality. The lowest IA (1.07 ± 0.66) and IT values (1.11 ± 0.49) were recorded during autumn. These results have significant implications for establishing national guidelines and nutrition standards, particularly for preschool-aged children, aiming to enhance health outcomes and mitigate the burden of chronic diseases on the healthcare system in the Republic of Serbia. Improving the lipid quality of meals provided in kindergartens can contribute to these objectives.

Keywords: children; daily meal; lipid quality

Author Contributions: Conceptualization, L.T. and R.V.; methodology, L.T.; formal analysis, L.T.; investigation, M.P. and R.V.; data curation, L.T. and M.P.; writing—original draft preparation, R.V.; writing—review and editing, L.T. and S.B.; project administration, L.T.; funding acquisition, M.P. All authors have read and agreed to the published version of the manuscript.

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Development and Validation of a Food Frequency Questionnaire to Assess Polyphenol Intake and Its Association with Inflammation in the Portuguese Population: Study Plan [†]

Lizaveta Hilman , Cláudia Nunes Santos  and Nuno Mendonça *



Belgrade, Serbia, 14–17 November 2023.

Citation: Hilman, L.; Santos, C.N.; Mendonça, N. Development and Validation of a Food Frequency Questionnaire to Assess Polyphenol Intake and Its Association with Inflammation in the Portuguese Population: Study Plan. *Proceedings* **2023**, *91*, 360. <https://doi.org/10.3390/proceedings2023091360>

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Abstract: Background: Conditions like inflammatory bowel disease (IBD) are lifelong inflammatory diseases that involve chronic inflammation of the gastrointestinal tract. Polyphenols are phytochemicals that are found in plant-based diets and possess beneficial health properties. Nutritional research has reported that a higher intake of polyphenols is associated with several health benefits. However, despite the health importance, measuring polyphenol intake in free-living subjects is challenging. There is a need to quantify polyphenol intake. Currently, there is a lack of validated food frequency questionnaires (FFQs) available for the assessment of polyphenol intake in the Portuguese population. Objectives: The purpose of this research is to (1) develop and validate a new food frequency questionnaire to assess the dietary polyphenol intake in the Portuguese population and (2) to use the validated FFQ to assess the relationship between the polyphenol intake and the inflammatory status in IBD patients. Hypothesis: Higher polyphenol intake is negatively associated with inflammatory biomarkers, such as calprotectin, C-reactive protein and inflammatory cytokines in IBD. Methods: To develop a semiquantitative FFQ consisting of max. 150 items by adapting the existing Portuguese FFQ and adding polyphenol-rich foods. Polyphenol data will be obtained from Phenol-Explorer, the USDA database, published literature and laboratory total phenol analysis. Dietary intake will be obtained from 100 adults. Population group—Portuguese, male and female. Validation will be calculated using the Wilcoxon signed-rank test, Spearman’s correlation and Bland–Altman statistics between 24-HRs and FFQs, corrected for attenuation from the within-person variation in the recalls. Discussion: A study will be conducted to assess the polyphenol intake using the validated FFQ in free-living IBD patients, and to measure the symptom severity and inflammatory biomarkers (C-reactive protein, inflammatory cytokines and calprotectin) to assess the association between the polyphenol consumption and the inflammatory status of IBD patients. Based on these data, patients will be stratified by low, medium or high polyphenol consumers and correlated with inflammation and symptom severity.

Keywords: FFQ; polyphenols; validation; 24-HR; inflammatory bowel disease; IBD; inflammation

Author Contributions: Conceptualization, C.N.S. and N.M.; Investigation, Writing—Original Draft Preparation, Writing—Review & Editing, L.H., C.N.S. and N.M.; Supervision, C.N.S. and N.M.; Funding Acquisition, C.N.S. All authors have read and agreed to the published version of the manuscript.

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Vitamin E and Cardiovascular Disease Risk Factors in Adults: Results from the Health Survey of São Paulo with Focus on Nutrition (ISA-Nutrition) [†]

Marcela Larissa Costa ^{1,*}, Cristiane Hermes Sales ¹, Paula Victoria Felix ¹, Jaqueline Lopes Pereira ¹,
Marcelo Macedo Rogero ¹, Flavia Mori Sarti ² and Regina Mara Fisberg ¹



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Abstract: Background and Objectives: Dietary vitamin E intake has high rates of inadequacies in Latin America, which may be potentially associated with increased cardiovascular risk. The objective of this study was to compare vitamin E intake and plasma vitamin E concentrations among cardiovascular disease risk factor (CVDR) groups from adults living in the urban area of São Paulo, Brazil. Methods: Data from 198 individuals aged 18 to 59 years were obtained from the 2015 Health Survey of São Paulo, a population-based cross-sectional study. Dietary intake was measured using two 24 h dietary recalls, and the usual dietary intake of vitamin E was calculated using the Multiple Source Method. Blood samples were analyzed to obtain plasma vitamin E concentration, serum lipid profile, insulin, and fasting glucose. Blood pressure, weight, and height were collected, and body mass index was calculated. CVDR was categorized as having three or more conditions: obesity, elevated systolic or diastolic blood pressure, dyslipidemia, and high fasting plasma glucose or insulin resistance. Student's *t*-test assessed comparisons between vitamin E values in groups of cardiovascular risk factors. Results: The mean intake of vitamin E was 6.43 mg/d, which was equivalent to 53.65% of the EAR reference values. Ninety eight percent of the sample had dietary inadequacy of vitamin E. Mean plasma α -tocopherol was 19.98 μ mol/L. The majority of the sample was female (57.6%), and 29.1% had three or more CVDR. Plasma values of α -tocopherol differed between individuals with three or more CVDR (mean: 21.86; SD: 9.16 μ mol/L) compared to those with less than three CVDR (mean: 29.24; SD: 7.30 μ mol/L), observing $t(196) = -1.87, p = 0.003$. There were no statistical differences in vitamin E intake between CVDR groups. Discussion: Our findings showed the severe inadequacy of vitamin E intake in the adult population of São Paulo. Moreover, individuals with higher numbers of CVDR had lower plasma values of vitamin E, which may indicate a necessity to increase vitamin E intake in individuals at higher risk. These results are particularly worrying, given the preventive function vitamin E intake may provide for individuals at higher cardiovascular risk.

Keywords: vitamin E; cardiovascular risk factors

Author Contributions: Conceptualization, M.L.C., C.H.S. and R.M.F.; methodology M.L.C., P.V.F. and J.L.P.; formal analysis M.L.C. and P.V.F.; investigation, M.L.C. and C.H.S.; resources, M.M.R., F.M.S. and R.M.F.; writing—original draft preparation, M.L.C.; writing—review and editing, J.L.P., C.H.S., M.M.R., F.M.S. and



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The Association between Body Fluid Rate with Plasma Lipid Profile, Independent of Adiposity in Young Adults [†]

Xin Liu * , Junqi Li, Jiawen Xie, Guoqing Ma, Kun Xu and Jiaomei Yang



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Objectives: Body water is fundamental in human metabolism. The current study aimed to evaluate the associations between body fluid rate (BFR) with plasma lipid profiles, including triglycerides, total cholesterol, and high-density lipoprotein (HDL)/low-density lipoprotein (LDL) cholesterol, among apparently healthy young Chinese adults. Methods: The study subjects were from the phase 1 sample of the ‘Carbohydrate Alternatives and Metabolic Phenotypes’ study. After excluding those lacking blood samples, a total of 95 subjects with an average age of 22.6 years were included in the analysis. Total body water (TBW) and body fluid rate (BFR) were measured using bioelectrical impedance analysis (TANITA, BC-420). General linear regression was used to evaluate the associations between body fluid rate with plasma lipid profiles. Results: The mean (SD) of TBW was 39.7 (4.7) kg and 26.8 (2.2) kg for males and females, respectively, while the mean (SD) of BFR was 55.8 ± 3.1 and 50.4 ± 2.1 for males and females, respectively. After adjusting for age, sex, education attainment, smoking status, alcohol drinking habits, and physical activity level, negative associations (β , SE) were observed between BFR with triglycerides (−0.06, 0.02, $p < 0.001$) and LDL cholesterol (−0.07, 0.02, $p = 0.003$), while no significant associations were detected for total cholesterol (−0.06, 0.03, $p = 0.052$) and HDL cholesterol (0.02, 0.01, $p = 0.074$). These associations were not substantially changed with further adjustment of body mass index. In the stratified analysis by gender, the direction of the associations was not changed, but BFR was negatively associated with LDL cholesterol (−0.09, 0.04, $p = 0.049$) in males, and with triglycerides (−0.05, 0.02, $p = 0.043$) in females only. Conclusions: In apparently healthy young Chinese adults, BFR was negatively associated with triglycerides and LDL cholesterol, independent of body adiposity level.

Keywords: body fluid rate; lipid profile; adiposity

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Effects of Time-Restricted Hypocaloric Mediterranean Diet in Patients with Non-Alcoholic Fatty Liver Disease: Preliminary Data from the CHRONO-NAFLD Project [†]

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Abstract: Background and objectives: Non-alcoholic fatty liver disease (NAFLD) is spreading at alarming rates, representing a serious public health problem, and it is the most common cause of chronic liver disease. This study aims to evaluate the effects of time-restricted feeding (TRF) along with a hypocaloric Mediterranean Diet (MD) on body weight and biochemical indices. Methods: This 12-week, open-label, randomized controlled trial [NCT05866744] consists of three interventional groups following a personalized diet (1500–2100 kcal/day): control group (MD without time restriction), early 14:10 TRF, and delayed 14:10 TRF. Anthropometric measurements and biochemical analyses are carried out at baseline and 12 weeks. Results: We recruited sixty NAFLD patients with a mean body mass index (BMI) of 31.8 ± 0.8 kg/m² and a mean age of 51.05 ± 2.74 years, out of whom twenty-one (10 males, 47.6%) have completed the ongoing trial (control $n = 7$, early TRF $n = 6$, delayed TRF $n = 8$). There was no difference in body weight between the groups at 12 weeks, but each group lost significant body weight compared to baseline (control: 6.3%, $p = 0.015$; early and delayed TRF: 8%, $p = 0.004$, and $p = 0.001$, respectively). The three groups differed in total cholesterol, triglycerides, and low-density lipoprotein cholesterol levels at 12 weeks. Significant decreases in BMI, waist circumference, hip circumference, fat mass, and systolic and diastolic blood pressure were observed in all groups. Additionally, in the control group, there was a decrease in fasting insulin, homeostatic model assessment for insulin resistance (HOMA-IR), alanine aminotransferase, and controlled attenuation parameter derived from elastography; while in the early TRF group, there was a tendency for lower glycated hemoglobin A1c. Finally, in the delayed TRF group, fasting glucose, gamma-glutamyl-transferase, and alkaline phosphatase were improved compared to baseline. There was no difference in pleasure rate between the three interventions at baseline or 12 weeks. Discussion: These preliminary data show that 14:10 TRF led to clinically significant weight loss (>5%), mainly via fat mass loss, and to an improved lipid profile, regardless of the time restrictions placed on food intake. Consequently, TRF could be an alternative weight loss strategy for individuals with NAFLD.

Keywords: non-alcoholic fatty liver disease; time-restricted feeding; Mediterranean diet; glucose metabolism; weight loss

Author Contributions: Conceptualization, S.T., E.P., E.C. and K.-A.P.; methodology, research, and data analysis, S.T.; volunteers' assessment; S.T., E.C., T.B. and A.N.; original draft preparation, S.T.; writing—review and editing, S.T., E.P. and E.C. All authors have read and agreed to the published version of the manuscript.

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Can Planetary Health Mean Population Health? Higher Adherence to the EAT-Lancet Reference Diet Is Inversely Associated with Mortality in a UK Population of Cancer Survivors [†]

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Tilman Kühn ^{7,8,9} and Sabine Rohrmann ^{1,2}



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Abstract: Background and Objectives: Advancements in treatment and care, as well as early detection, have contributed to an increase in cancer survival rates. However, limited evidence exists on the optimal diet that should be followed by people after receiving a cancer diagnosis and how it may affect their survival outcomes. Recently, the EAT-Lancet Commission on Food, Planet, Health proposed the “planetary health diet” as a diet within the planetary boundaries. We aimed to investigate, for the first time, the association between adherence to the EAT-Lancet reference diet and mortality in cancer survivors. Methods: Using data from the UK Biobank cohort, we created a sub-population of cancer survivors, based on cancer-registry diagnoses. Data from the UK Biobank’s Touchscreen questionnaire were used to develop a score reflecting adherence to the EAT-Lancet reference diet. Cox proportional hazards regression models were fitted to assess the association of the EAT-Lancet reference diet score with all-cause, cancer, and cardiovascular mortality in cancer survivors. Results: Better adherence to the EAT-Lancet reference diet was inversely associated with all-cause and cancer mortality, while mostly null associations were seen for cardiovascular mortality. Stratified analyses using potential effect modifiers led to largely similar results. Discussion: Our findings support the notion that the adoption of the EAT-Lancet reference diet has the potential to be beneficial for cancer survivors. Additional studies are needed in this specific population to further assess their post-diagnostic needs as well as the perceived barriers to the adoption of healthy lifestyle habits.

Keywords: EAT-Lancet; cancer; survivors; mortality; UK Biobank cohort; prospective

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Characterising Diurnal and Irregularity Eating Patterns and Their Relationship with Obesity in the Italian Population in the INRAN-SCAI 2005–2006 Nutrition Survey [†]

Luigi Palla * and Laura Lopez Sanchez



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Abstract: Background and Objectives: Late food intake has been linked to weight gain while early meals have been associated with weight loss and maintenance. However, the impact of temporal (diurnal) eating patterns summarising the time of food intake throughout the day and the eating time irregularity across surveyed days has been less investigated. INRAN-SCAI is a cross-sectional nutrition survey conducted in 2005–2006 in a representative sample of the Italian population, collecting diet diaries over 3 days, including a questionnaire with socio-demographic and anthropometric variables. We aimed to characterise diurnal and irregularity eating patterns (DIEPs) and investigate their association with BMI/obesity in Italian adults (18–64 ys). Methods: We derived the DIEPs by Principal Component Analysis (with covariance matrix) jointly on indices of average and irregularity of energy intake using the reduced six time intervals corresponding to common eating time slots in Italy. The first five DIEPs explained 93% of the total variance, with the first DIEP score increasing with energy intake at main meals. A mixed-effect model with random intercept accounting for the correlation within household (ICC) was applied including only adults (complete case analysis $n = 2022$), with BMI as outcome, the main DIEPs as exposures and a set of confounders identified by a causal diagram. Results: The model resulted in a positive association of BMI with the first DEP ($b = 0.75$ per 100% score, $p = 0.009$; ICC = 0.195, $p < 0.0001$). A positive significant association also resulted between BMI and the third DIEP (10% variance) whose score increased with energy intake at snack times outside main meals ($b = 0.89$ per 100% score, $p = 0.013$) and with the fifth DIEP (6.4% variance), which mainly captured food intake at night and irregularity of intake at night ($b = 0.34$ per 100% score, $p = 0.028$). Discussion: Despite the limitations of a cross-sectional design, this study indicates that in the Italian adult population BMI tended to increase not only with large energy intake at main meals and at snack times but also with energy intake and irregularity of intake at night. This is in line with recent findings in the British population, indicating the relevance of surveying and modifying DIEPs, beside average daily intake, for obesity management.

Keywords: chrononutrition; obesity; nutrition survey; principal component analysis

Author Contributions: Conceptualization, L.P.; methodology, L.P.; software, L.P. and L.L.S.; formal analysis, L.P. and L.L.S.; data curation, L.L.S.; writing—original draft preparation, L.P. and L.L.S.; writing—review and editing, L.P.; supervision, L.P.; project administration, L.P.; funding acquisition, L.P. All authors have read and agreed to the published version of the manuscript.

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Dietary Habits as Acne Trigger [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Acne is the most common skin disease in the world and reason to visit a dermatologist. It affects more than 95% of adolescents, 3% of men and 12% of adult women. Exposure to stress, fast lifestyles, hormonal imbalances, gut dysbiosis, associated diseases, and eating habits can significantly contribute to the worsening of acne. The modern concept of acne treatment is holistic, and pays significantly more attention to the human microbiota than before. A properly balanced diet provides nutrients that the human body needs to function and reduces the appearance of acne. Significant differences between adults and adolescents have been observed in the daily intake of PUFAs and calcium, and nearly significant differences have been reported for vitamin B intake. Adults consume a more balanced diet compared to adolescents. Subjects and methods: Using a questionnaire, data were collected (anthropometry, general health status, comorbidities, use of medicines and supplements, dietary and lifestyle habits; additional data on women and the menstrual cycle) from 60 dermatological patients of both genders, aged 15–46 years, from Sarajevo. A significance level of 0.05 was used. Analysis was performed using Statistica software (version 14.0, StatSoft Inc., Tulsa, OK, USA). The research aimed to determine whether and how dietary habits influence the severity, etiology, and incidence of acne in both genders. Results and Discussion: The average BMI of the patients was 22.4 ± 3.4 kg/m². It was found that men have less acne, but a more severe form. In total, 53% of patients had a positive family history of acne. The majority of acne has an unknown etiology (41.7%), followed by bacterial (30%) and hormonal (28.3%) causes. Hormonal acne was present exclusively in women. The average compliance of the patient’s diet with the principles of the Paleo diet was 54%, and the respondents most rarely consumed fish, and very often sweets, salty and fast food. Significant differences between the adults and adolescents were found in the daily intake of PUFAs ($p = 0.023$) and calcium ($p = 0.049$), and nearly significant differences in vitamin B intake (pvit B9 = 0.059). Supplements were taken daily by 82% of the respondents, most often including herbal teas (67%), vitamin C (40%), and vitamin D (38%). Whey protein was consumed by 10% of the patients, and it has been confirmed that this can be a trigger for the appearance of acne. Conclusions: A positive correlation was found between the number of meals and the severity of acne. Patients with fewer meals per day had a mild form of acne.

Keywords: acne; adolescents; adults; dietary habits; supplements

Author Contributions: Conceptualization, methodology, software, validation, formal analysis, I.B. and E.K.F.; investigation, T.J.S.; resources, data curation, writing—original draft preparation, E.K.F.; writing—review and editing, I.B.; visualization, E.K.F.; supervision, project administration, I.B. All authors have read and agreed to the published version of the manuscript.

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An Animal Model to Investigate Postprandial Metabolism [†]

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Abstract: Background and Objectives: Bile acids (BA) are recognized as metabolic integrators that participate in the regulation of energy metabolism and inflammation. Their concentration in the plasma increases several-fold after a meal. The postprandial period is characterized by physiological changes to accommodate the alterations in nutrient availability and a systemic inflammatory response. An animal model would be an important tool to investigate postprandial metabolism, but there is no fully characterized model, and it is uncertain whether human responses to a meal can be reproduced in animals. This study aimed to characterize an animal model for investigating postprandial metabolism and inflammation, with a focus on the role of BA in the modulation of postprandial inflammation. Methods: Changes in plasma BA levels and hepatic cytokine concentrations were investigated in male

Sprague-Dawley rats ($n = 50$) at different time points after the ingestion of a high-fat meal (fasting, 60, 120, 180, and 300 min). Results: Plasma BA levels were quantified using liquid chromatography-mass spectrometry (LC-MS/MS), and hepatic inflammatory marker content was assessed using Western blotting. As a result, we observed that unlike humans, rats showed a predominance of unconjugated BA (~70%) both during fasting and throughout the postprandial period in the plasma, with cholic acid being the most abundant species (~36%). On the other hand, rats exhibited a postprandial inflammatory response with a temporal resolution like that observed in humans. In the liver, two hours after meal ingestion, the content of Toll-like receptor 4 (TLR-4) was 30% higher than in the fasting state ($p = 0.0071$). Discussion: TLR-4 is a receptor that interacts with intracellular adaptors to activate tumor necrosis factor κ B (NF- κ B), which also increased in the liver three hours after meal ingestion ($p = 0.0208$). Increased hepatic mRNA expression of interleukin 6 (IL-6) and interleukin 1 β (IL-1 β) was also observed at 60 min. Preliminary analysis demonstrated that rats exhibit postprandial inflammation in the liver and may constitute a valid experimental model to investigate postprandial alterations also observed in clinical trials.

Keywords: bile acids; post-prandial; energy metabolism; meta-inflammation; metabolomics

Author Contributions: Conceptualization, L.R. and J.F.; methodology, J.F. and K.H.; formal analysis, L.R., C.M.D.-P. and T.M.; investigation, L.R., C.M.D.-P., A.D.V. and V.B.M.; resources, J.F. and K.H.; writing—original draft preparation, L.R.; writing—review and editing, L.R. and J.F.; supervision, J.F. and K.H. All authors have read and agreed to the published version of the manuscript.

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Markers of Dysmetabolism Revealed Using a Dietary Challenge and Dry Blood Spots in a Remotely Executed Clinical Trial [†]

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Abstract: Background and Objectives: The physiological changes that take place after the ingestion of a meal are largely controlled by insulin and can reflect changes in the response to this hormone. Different studies have reported metabolic differences among groups of subjects in the postprandial state, while failing at detecting differences in the fasted state. Dry blood spots (DBS) are a non-invasive tool for sampling and storing small volumes of biological fluids, useful in biomarker discovery studies or the analysis of responses to interventions. The aim of this study was to identify markers of dysregulated glucose postprandial metabolism in a clinical study conducted remotely, using DBS as a sampling strategy. Methods: 100 males and females (18–60 y.o., BMI: 18.5–34.9 kg/m²) went through a dietary challenge based on the intake of an energy-dense meal (75 g glucose, 60 g canola oil and 20 g casein) and blood sampling (as DBS) at 0, 30, 60, 90, 120 and 150 min. Capillary glycaemia was monitored using a portable glucometer. DBS samples were analyzed in an untargeted metabolomic platform using gas chromatography coupled to mass spectrometry. Results: The outcomes of the study confirm the viability of the remotely executed clinical study. Performing the dietary challenges at the homes of the study subjects did not interfere with the quality of the data collected. The subjects were sorted according to glucose AUC and divided into two groups. The blood levels of markers of insulin resistance such as branched-chain amino acids and tyrosine were increased in the subjects with the larger glucose AUC. The concentration of metabolites associated with glucose metabolism (monosaccharides, lactate and Krebs cycle metabolites) were also increased in the blood of individuals with higher AUC, in comparison to those with lower AUC values. Moreover, 30 other unidentified metabolites also displayed higher concentrations in the DBS collected from individuals with larger AUC of glucose, indicating a number of compounds with marker quality that remain to be identified. Discussion: This is the first clinical study that employed DBS as a sampling strategy during a dietary challenge and successfully described a metabolic signature of glucose metabolism dysregulation.

Keywords: metabolomics; GC-MS; DBS; metabolism; postprandial

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Effect of Fermented Food Products as Vitamin K Dietary Sources on the Development of Atherosclerotic Lesions in ApoE/LDLR^{-/-} Mice[†]

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Abstract: The term vitamin K refers to a group of similarly structured fat-soluble compounds. One of the vitamin K forms is phyloquinone, known as vitamin K1. The main nutritional sources of vitamin K1 are green, leafy vegetables like kale, beetroot, spinach and broccoli. Other forms of vitamin K are menaquinones (vitamin K2) that can further be divided into a few subtypes depending on the number of isoprenoid residues in the side chain (MK-n). Besides MK-4, bacteria synthesize all menaquinones. As such, the main dietary sources of vitamin K2 are natto, dairy (especially fermented products, e.g., cheese), meat and eggs. Until recently, vitamin K was associated with the regulation of the coagulation system. Interest in the biological activity of these compounds increased once it was discovered that vitamin K2 affects the processes of the calcification of both bones and soft tissues. Vitamin K can reduce oxidative stress and inflammation. The objective of the present study was to verify the hypothesis about the effectiveness of dietary vitamin K2 as an anti-atherosclerotic agent. An in vivo experiment on ApoE/LDLR^{-/-} mice was conducted to verify this hypothesis. Two month-old mice were fed AIN-93G modified diets containing vitamin K-rich products, i.e., natto, cheese (Munster), sauerkraut and synthetic vitamin K2 MK-7 (100 µg/kg b.w./day) for 8 weeks. The body weight, weight of organs and glucose concentration were determined. Blood was taken and the aorta dissected. The investigation included both the area of lesions and biochemical parameters such as lipid profile. Quantification of the atherosclerotic area in entire aorta was performed by an en face method. The lipid profile was determined automatically by ABX Pentra 400 (Horiba Medical, Kyoto, Japan). The concentration of vitamins K was determined using UHPLC-MS/MS technique in faeces. Body weights of mice fed MK-7 and Munster were significantly decreased compared to Control (respectively, 20.01 and 19.98 vs 21.45 [g]). Liver's weight of mice fed Munster was significantly increased in comparison to other groups (5.70 vs 4.53 [g/100g] in Control). Glucose concentration was unchanged. Significant changes in plasma lipid profile of mice fed modified diets, especially in groups fed Munster and Sauerkraut, were observed. Total cholesterol and LDL concentrations were significantly increased in Munster and Sauerkraut compared to Control (respectively, for TC 20.45 and 19.80 vs 15.95 [mmol/L]; for LDL 17.15 and 11.94 vs 7.85 [mmol/L]). Moreover, TAG level was significantly increased in Sauerkraut in comparison to Control (2.87 vs 2.23 [mmol/L]). The main forms of vitamin K identified in mouse faeces were menaquinones MK-6. Nutritional factors with an alleviating effect on the development of atherosclerotic plaques are still being investigated.

Keywords: vitamin K; fermented products; atherosclerosis; ApoE/LDLR^{-/-} mice

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N-3 Polyunsaturated Fatty Acid Profile Is Altered in Pregnant Women with Different Allergic Diseases [†]

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Abstract: The incidence of allergic problems has notably increased in recent decades, affecting approximately 20% of the population and becoming a public health issue. Some studies have suggested that asthma and atopy could result from an increased dietary intake of n-6 polyunsaturated fatty acids (PUFA) and a decreased intake of n-3 PUFA. During pregnancy, the fetus depends on the transplacental transfer of n-3 PUFA from maternal circulation, which implies that maternal lipid profile alterations might predispose to allergy onset during infancy and childhood. The aim of this study was to evaluate the circulating fatty acid profile in pregnant women with allergic problems as well as in fetal plasma at birth. Plasma samples from 73 allergic and 179 healthy pregnant women as well as cord venous plasma were collected at delivery in the NELA cohort (Murcia, Spain). Maternal allergy was diagnosed according to the symptoms and via a positive skin prick test. The fatty acid profile was determined by gas chromatography. The allergic mothers had a lower percentage of n-3 PUFA in the plasma compared to the healthy ones (Allergic: 4.06 ± 0.15 vs. Control: 4.66 ± 0.11 , $p = 0.002$), especially in those with asthma or food allergies. This contributed to a significantly higher n-6/n-3 PUFA ratio in women with allergies (Allergic: 9.45 ± 0.31 vs. Control: 8.28 ± 0.20 , $p = 0.002$), mainly asthma and food allergies, which was indicative of a proinflammatory status. The same tendency was observed in women affected by atopic dermatitis ($p = 0.094$). In cord blood, despite the fact that there were no differences in the n-6/n-3 PUFA ratio between the groups, the fetuses born from allergic mothers showed a tendency towards lower n-3 PUFA content compared to those born from healthy mothers (Allergic: 5.63 ± 0.19 vs. Control: 6.17 ± 0.21 , $p = 0.093$). In conclusion, allergy led to a decreased n-3 PUFA and an increased n-6/n-3 ratio fatty acid profile in pregnant women at delivery, especially in those affected by asthma and food allergies. The same tendency was observed in cord plasma. A higher n-3 PUFA consumption could be desirable in women with allergic diseases in order to improve their lipid profile and proinflammatory status and their offspring's health.

Keywords: fatty acid; pregnancy; allergy; omega-3

Author Contributions: Conceptualization, A.G. and E.L.; methodology, A.G., A.M.E.-M., M.S.-M., V.O. and M.D.M.-R.; formal analysis, A.G. and E.L.; investigation, A.G., A.M.E.-M. and M.S.-M.; resources, L.G.-M. and E.L.; writing—original draft preparation, A.G. and E.L.; writing—review and editing, A.G., L.G.-M. and E.L.; supervision, E.L.; project administration, L.G.-M.; funding acquisition, L.G.-M. and E.L. All authors have read and agreed to the published version of the manuscript.

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Abstract

Diet-Specific Multi-Omics Markers Associated with Metabolic Health Benefits Can Be Determined in Vegan Population [†]

Anna Ouradova ^{1,*}, Monika Cahova ², Jan Gojda ¹, Alessio Naccarati ³, Giulio Ferrero ⁴, Marina Henikova ¹
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Abstract: Background and objectives: Diet is one of the fundamental factors that not only determines metabolic health but also shapes the gut microbiome and serum metabolome (MIME). Plant-based diets are associated with potential health benefits, but their effect on MIME remain to be elucidated. We sought to determine whether diet-dependent markers explaining the observed health benefits of a vegan diet could be identified in the MIME of vegans from different geographic regions. Methods: Lean, healthy vegans ($n = 100$) and omnivores ($n = 73$) with comparable BMI from two geographical regions (Czech Republic, Northern Italy) participated in the cross-sectional study. Based on their clinical characteristics and serum markers, we investigated their glucose and lipid metabolism and used an integrated multi-omics approach (16S rRNA sequencing, metabolomics and lipidomics profiling) to identify country- and diet-specific MIME markers. Results: Czech and Italian vegans exhibited more favorable lipid profile parameters compared to omnivores characterized by decreased serum concentrations of sphingomyelins, ceramides, cholesterol esters, and lipid species containing saturated fatty acid. Using a machine learning approach, we were able to discriminate between vegans and omnivores based on separate omics datasets, regardless of country of origin. By combining all MIME features, we were able to identify a vegan diet-specific multi-omics signature that allows for the classification of vegans and omnivores with high accuracy. Most of the vegan-specific variables were associated with favorable indices of lipid and glucose metabolism, inflammation, or body weight. Discussion: Most of the MIME markers that are down-regulated in vegans are predominantly associated with adverse health outcomes, whereas those that are up-regulated are associated with a healthy phenotype and a low risk of non-communicable diseases. Our findings support the potential use of a healthy plant-based diet in the treatment of metabolic disorders.

Keywords: vegan diet; multi-omics; lipidomics; gut microbiota; NCDs

Author Contributions: M.C., A.N., J.G. and G.F. designed and initiated the study. M.C., A.O., M.H. and T.A. drafted the abstract. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Variant of SNP 1799930 Identifies the Protective Character of High Metabolizing of Xenobiotics in Individuals with Overweight and Obesity [†]

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Abstract: Background and Objectives: Enzymes involved with acetylation capacity affects the metabolism of several xenobiotics that can be deposited in adipose tissue and hinder weight loss, leading to obesity. Our aim was to identify single nucleotide polymorphisms (SNPs) related to the xenobiotic's metabolism and to associate such with the serum levels of heavy metals in an individual with excess body weight. Methods: The sample was selected at the Ribeirão Preto Medical School at the University of São Paulo, Brazil. Genotyping arrays were performed with 23 SNPs.

Quality control and imputation steps were applied using the functions in the package 'snpReady' (CRAN) and 'imput' (Bioconductor). Results: This study selected 189 individuals of mixed ethnicity of both sexes, with a mean age of 42.2 ± 12.9 years and a mean BMI of 45.1 ± 11.4 kg/cm². From the cluster of 23 evaluated SNPs, we observed a higher frequency of SNP 1799930 in the NAT2 gene (N-acetyltransferase). The genotypes were correlated to the serum levels of different metals. We observed that individuals homozygous for the mutant allele (AA), called fast metabolizers, had lower levels of aluminum (Al) (51.4 ± 18.9 µg/L) compared to those considered slow metabolizers (GG) (64.0 ± 37.2 µg/L; $p = 0.02$). No difference was observed when compared with heterozygosity (AG). Furthermore, the BMI of fast metabolizers (48.7 ± 12.8 kg/cm²) was higher than the slow metabolizer individuals (45.9 ± 10.4 kg/cm²; $p < 0.05$). Discussion: Fast metabolizers seem to have a greater Al metabolism only in homozygosis, that is, the dose-dependent gene, to exert its effect. Interestingly, the presence of the AA genotype is associated with a higher BMI, suggesting that larger studies should be carried out investigating the deposition of metals in adipose tissue.

Keywords: aluminum; mutant allele; SNP; obesity; xenobiotics

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Are There Differences in Cytokine Profiles between Vegetarians and Omnivores? [†]

Marta Despotović , Slavko Mojsilović , Ivana Šarac * , Jasmina Debeljak Martac'ić , Gordana Petrović Oggiano , Petar Jovanović and Marija Takic'



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Abstract: Background: According to scientific evidence, plant-based diets like vegetarian diets may be protective against chronic inflammatory disease. To date, the association of vegetarian nutrition with circulation CRP levels has been noticed and confirmed using meta-analyses. However, further studies are needed to clarify the possible associations between other inflammation markers and vegetarian diets since such data are lacking. Objective: in this study, we investigated the serum levels of a panel of cytokines in vegetarians compared to omnivores by performing flow cytometry quantification of 13 cytokines using a commercially available LEGENDplex bead-based immunoassay kit. Methods: This study included apparently healthy subjects: 80 omnivores and 80 subjects who had been on a vegetarian diet for at least 2 years (67 vegans and 13 lacto-ovo vegetarians). Omnivores and vegetarians were matched for gender, age, and body mass index (BMI). Results: Statistically significant lower circulating levels of IFN- γ ($p < 0.01$), TNF- α ($p < 0.05$), IL-6 ($p < 0.05$), IL-8 ($p < 0.05$), IL12p70 ($p < 0.05$), and IL-17A ($p < 0.01$) were found in vegetarians compared to omnivores. We also observed a trend for similar differences in IL-10 levels ($p = 0.085$). The levels of IL-1 β , IFN- α 2, MCP-1, IL-18, IL-23, and IL-33 did not statistically differ between the studied groups. Discussion: This study shows the link between plant-based diet and reduced levels of pro-inflammatory cytokines. In conclusion, the levels of some pro-inflammatory cytokines might be influenced by a plant-based diet, suggesting that this type of diet leads to the modulation of the cytokine network and inflammation responses.

Keywords: cytokines; immunity; inflammation; vegetarian; diet

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Comparative Analysis of Fatty Acid Profiles in Erythrocyte Membranes in Vegetarians Compared to Omnivores [†]

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Abstract: Background: The fatty acid profiles in cellular membranes can be influenced by many endogenous and external factors, including diet. They are also associated with numerous metabolic and health conditions, including cardiovascular diseases and inflammation. Objective: This study provides a comparative analysis of the fatty acid profiles in subjects on vegetarian and omnivorous diets. Methods: The study enrolled 152 apparently healthy subjects, comprising 78 omnivores and 74 individuals who had followed a vegetarian diet for a minimum of 2 years, including 61 vegans and 13 lacto-ovo vegetarians. The subjects in the omnivore and vegetarian groups were matched by gender, age, and body mass index (BMI). The composition of the fatty acids in their erythrocyte membranes was determined using gas–liquid chromatography and presented as a percentage of total fatty acids. Results: The study revealed statistically significant differences in the fatty acid profiles: vegetarians had higher levels of oleic acid (OA, 18:1 n-9) ($p < 0.001$) and linoleic acid (LA, 18:2 n-6) ($p < 0.001$), while at the same time having lower levels of gamma-linolenic acid (GLA, 18:3 n-6) ($p < 0.05$), eicosapentaenoic acid (EPA, 22:5 n-3) ($p < 0.001$), docosapentaenoic acid (DPA, 22:5 n-3) ($p < 0.001$), docosahexaenoic acid (DHA, 22:6 n-3) ($p < 0.001$), and total omega-3 polyunsaturated fatty acid (PUFA) ($p < 0.001$) and a lower omega-3 index ($p < 0.001$). Additionally, they had lower omega-3 to omega-6 PUFA ($p < 0.001$); EPA/arachidonic acid (ARA, 20:4 n-6) ($p < 0.001$); and DHA/ARA ratios ($p < 0.001$). The activity of delta-6 desaturases (D6D), estimated as the GLA/LA ratio, was higher in the omnivores ($p < 0.005$), while the activity of elongase 2 (ELOV2), estimated as the DPA/EPA ratio, was higher in the vegetarians ($p < 0.005$). Most of the differences presented in both vegans and vegetarians, except for GLA and D6D, where differences were observed only in vegans compared to omnivores. Discussion: This study highlights the distinct fatty acid profiles associated with vegan, lacto-ovo vegetarian, and omnivorous diets, suggesting their differential impact on inflammation, disease protection, and overall health. Understanding the implications of the fatty acid profiles within these dietary patterns can be used for personalized nutritional recommendations and supplementation for individuals adhering to specific dietary lifestyles.

Keywords: fatty acids; omega 3; vegan; vegetarian; diet

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Impact of Nutrition Intervention on Mental Health Outcomes in Adults: Preliminary Evidence from a Systematic Review and Meta-Analysis [†]

Lydney Montgomery ^{*}, Helene McNulty, Mary Ward , Shane Gordon , Michelle Clements, Leane Hoey

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Abstract: Background and objectives: Mental health disorders are the leading cause of ill health and disability in adults, with depression and anxiety being the most prevalent. Emerging evidence indicates roles for specific nutrients—particularly, omega-3 fatty acids, vitamin D, folate, and the metabolically related B vitamins (B12, B6 and riboflavin)—in protecting against depression and anxiety, but the evidence is conflicting. The aim was to conduct a systematic review and meta-analysis investigating the effect of intervention with nutritional factors on mental health outcomes in adults. Methods: Searches were conducted using the following electronic bibliographic databases: MEDLINE, EMBASE and PsycINFO. Inclusion criteria were randomised controlled trials (RCTs) or controlled dietary interventions, participants aged ≥ 18 years, study duration ≥ 12 weeks and depression or anxiety outcome measures. The risk of bias and quality of the evidence were assessed using the Cochrane Risk of Bias 2 tool and the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) framework, respectively. Results: A total of 83 studies met the inclusion criteria, of which 73 were included in the meta-analysis. Regarding the role of specific nutrients in depression, RCTs with B vitamins (standardised mean difference, SMD, -1.91 95% CI -3.69 , -0.13) and zinc (SMD -0.59 95% CI -0.86 , -0.30) indicated significant benefits in reducing depression. Although no overall effect of vitamin D intervention in reducing depression for studies was found, subgroup analysis showed a beneficial effect of 12-week duration (SMD -0.29 95% CI -0.57 , -0.01), while no significant effect of omega-3 fatty acid intervention was observed (SMD -0.47 95% CI -0.98 , 0.04). RCTs with vitamin D indicated beneficial effects in reducing anxiety (SMD -0.69 95% CI -1.27 , -0.11). No significant effect of omega-3 fatty acids on anxiety was shown, while there were insufficient RCTs with B vitamins and zinc in relation to anxiety.



Discussion: This preliminary analysis demonstrated a potential role for B vitamins, vitamin D and zinc, but no benefit of intervention with omega-3 fatty acids, on depression. Vitamin D may play a role in reducing anxiety, whereas omega-3 does not. Confirmation of these preliminary findings is required from new RCTs with relevant nutrients.

Keywords: mental health; depression; anxiety

Author Contributions: Conceptualization, H.M. and C.H.; methodology, H.M. and C.H.; formal analysis, L.M.; performed the statistical analysis, L.M. and S.G.; investigation, L.M., C.H., L.H. and M.C.; data curation, L.M., C.H. and L.H.; writing—original draft preparation, L.M.; writing—review and editing, L.M., C.H., L.H., M.W. and H.M.; supervision, C.H., L.H., M.W. and H.M.; project administration, L.M. All authors have read and agreed to the published version of the manuscript.

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Replacing Part of Maltodextrin with Galactose in Early Life Diet Results in an Improved Body Composition and Energy Metabolism in a Mouse Model [†]

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Abstract: Background: Lactose, a disaccharide of glucose and galactose, is the primary carbohydrate found in milk. Recently, there has been an increased demand for low lactose/lactose-free infant formulas. Maltodextrin (MDX) is a popular, alternative carbohydrate source in these formulas, yet the (long-term) health effects of consuming maltodextrin in early life are unclear. Previously, consuming galactose (partly replacing glucose) in a postweaning diet was shown to improve metabolic health in mice. Objective: To investigate the effects of partly replacing MDX with galactose in post-weaning diets on body composition and energy metabolism. Methods: Weaned, individually housed female C57BL/6JRCcHsd mice received isocaloric diets (in a dough ball format) with different carbohydrate profiles for three weeks (postnatal day (PN)21–PN42). GLUGAL (lactose mimic, n = 13) contained 15.7 en% glucose, 15.7 en% galactose and 14.9 en% MDX, and GAL (n = 12) contained 15.7 en% galactose, no glucose and 30.6 en% MDX. MDX (n = 13) contained 38.4 en% MDX and 7.9 en% glucose. Energy metabolism was assessed via indirect calorimetry from PN40–PN42. At PN42, all mice were challenged with a 40 en% high-fat diet (HFD) until PN105. Body composition was measured weekly using Echo-MRI. At PN105, fasted (4 h) mice were sacrificed for serum and tissue analysis. Results: At PN42, mice in both galactose-fed groups (GLUGAL and GAL) had a significantly lower body weight, fat mass and relative fat mass compared with the MDX group ($p < 0.0001$). The respiratory exchange ratio was significantly lower in both galactose-fed groups compared with the MDX group ($p < 0.05$), suggesting lower carbohydrate oxidation and thus higher relative fat oxidation levels. In parallel, both galactose-fed groups showed lower energy expenditure ($p < 0.05$). Discussion: The GAL mice were similar to the GLUGAL (lactose mimic) mice in terms of body weight, composition and energy metabolism, while being significantly different from the MDX group at PN42. These findings suggest an improvement of body composition and energy metabolism when replacing MDX with galactose. This study is the first to compare the effects of replacing part of MDX with galactose in early life and reinforces the impact of the type of carbohydrates on metabolic outcomes.

Keywords: galactose; maltodextrin; body composition; energy metabolism; lactose free; early life; post-weaning

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The Role of Chronotype on Body Composition, Eating Habits and Cardiometabolic Risk Parameters in a Sample of Overweight/Obese Subjects [†]

Sofia Lotti * , Monica Dinu , Marta Tristan Asensi , Giuditta Pagliai , Antonia Napoletano, Barbara Colombini  and Francesco Sofi 



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: In recent years, the role of chronotype in obesity has been hypothesised, as subjects with an evening chronotype showed worse eating habits. However, the results are still limited and conflicting. The aim of the study is therefore to assess differences in body composition, eating habits and cardiometabolic parameters according to chronotype in a sample of overweight/obese subjects. **Methods:** Overweight/obese subjects (BMI > 25 kg/m²) aged 18–65 years were recruited at the Clinical Nutrition Unit of Careggi University Hospital, Florence, from March to April 2023. The chronotype was defined through the Morningness–Eveningness Questionnaire (MEQ). Each participant underwent a body composition and a blood sampling. Information on eating habits was collected with a food frequency questionnaire and a 3-day food diary. **Results:** The study population consisted of 51 overweight/obese subjects (71% women; 29% men) with a mean age of 50.3 ± 13.5 years and a mean BMI of 29.4 ± 4.3. Based on the MEQ score, 13 participants had an evening chronotype (26%) and 38 (74%) a morning chronotype. No significant differences in weight and body composition according to chronotype were observed. However, differences emerged for eating habits, with a significantly ($p < 0.05$) higher number of evening subjects reported to consume sweets, soft drinks and fast food. Analysis of the food diaries showed that evening subjects had a significantly higher intake of daily calories (1867.6 ± 434. vs. 1612.2 ± 538.5 kcal/day), fat (78.2 ± 20.9 vs. 65.4 ± 23.8 g/day) and carbohydrates (226.1 ± 47.5 vs. 186.3 ± 77.6 g/day). The analysis of cardiometabolic risk circulating parameters showed that evening subjects had significantly lower folate values (4.69 ± 2.1 vs. 8.25 ± 6.36 ng/mL) than morning subjects, as well as significantly lower vitamin B12 values (349.6 ± 132.3 vs. 445.5 ± 144.5 pg/mL). **Discussion:** Evening subjects had worse eating habits and a higher intake of total daily calories, fat and carbohydrates, and also reported significantly lower values of folic acid and vitamin B12.

Keywords: obesity; chrono-nutrition; chronotype; dietary habits; cardiovascular risk

Author Contributions: Conceptualization, S.L., M.D. and F.S.; methodology M.D.; formal analysis, S.L.; investigation, S.L., M.D., B.C., G.P., M.T.A. and A.N.; data curation, S.L., M.D. and A.N.; writing—original draft preparation, S.L.; writing—review and editing, M.D., B.C., G.P., M.T.A. and A.N.; supervision, F.S. All authors have read and agreed to the published version of the manuscript. **Funding:** The research received no external funding.

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The Effect of a Maternal Cafeteria Diet on Adipose Tissue Browning in Rats and the Body Composition of Mothers and Their Offspring [†]

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Abstract: Obesity is a growing public health problem worldwide, including among pregnant women. The Western dietary pattern, with its high energy density and low nutritional value, supports excessive fat accumulation in the body and the obesity epidemic. Three types of adipose tissue are known: white (WAT), beige (BeAT), and brown (BAT). BAT and BeAT have the potential to oxidize fatty acids and glucose and dissipate energy in the form of heat. The aim of this study was to investigate the effects of a maternal cafeteria diet administered in an animal model prior to pregnancy, during pregnancy, and during lactation on the body composition and browning of adipose tissue of females and their offspring. Eight-week-old female Wistar rats were fed prior to conception, during pregnancy, and during lactation with a cafeteria diet (CAF) or a control diet (C). After weaning, the offspring were fed a standard AIN93G semisynthetic diet. Body mass and composition were measured (Minispec LF90II, Bruker). The transcript levels of *Ucp1* and *Cidea* in the rats' BeAT were determined using real-time PCR (LightCycler 480 II, Roche). The CAF offspring had lower body weights at PND 4 than the C group offspring (9.6 ± 0.3 vs. 10.4 ± 0.2 g, $p < 0.005$). CAF male and female offspring had lower body weight values than the control group from postnatal day (PND) 21 to 60 ($p < 0.05$). The amount of adipose tissue in females from the CAF group was lower than in group C females at PND 35 ($p < 0.05$). The CAF group had higher *Ucp1* transcript levels in male offspring at PND 40 and 45 ($p < 0.05$) than the C group, but the *Cidea* transcript levels did not differ between the groups. It was concluded that a maternal cafeteria diet affected the body weight of the offspring of both sexes. However, adiposity-related outcomes were affected in a sex-specific manner. The level of adipose tissue was lower only in female offspring. On the other hand, transcripts of the *Ucp1* gene, which is a marker of browning, were altered only in male offspring.

Keywords: cafeteria diet; *Ucp1*; adipose tissue; obesity

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Association of Inflammatory Biomarkers with the Gut Microbiota and Short-Chain Fatty Acids in Prediabetic Subjects [†]

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Abstract: Background and objectives: The gut microbiota performs many functions in the host organism, and metabolites derived from its activity, such as short-chain fatty acids (SCFA), are involved in immunometabolism. Alterations in gut microbial composition play an essential role in diseases such as heart failure, kidney disease, obesity, and diabetes mellitus. The current work aimed to analyze the associations of serum and fecal inflammatory biomarkers with the microbiota and SCFA in prediabetic subjects. Methods: 65 prediabetic patients, diagnosed according to the American Diabetes Association criteria, who participated in a randomized controlled intervention study with *Moringa oleifera* Lam. (2.4 g/day), were included. Inflammatory markers (Serum C reactive protein [CRP] and fecal calprotectin and sIgA), gut microbiota (qPCR), and short-chain fatty acids (SCFA; GC-FID) were studied before (V0) and after a 12-week intervention (V12). Relationships were explored using principal component analysis (PCA). Lineal regression models were performed to determine the predictive variables of inflammatory markers by including SCFA and gut microbiota groups as one block of independent variables. Fat mass percentage (BIA) and treatment group were used to adjust the models. Analyses were performed for V0 and V12 separately. Results: Only for calprotectin were significant models found at V0 ($p = 0.044$) and V12 ($p = 0.010$). *Lactobacillus* (standardized beta, $\beta = 0.292$; $p = 0.047$) and *Bacteroides* ($\beta = 0.430$; $p = 0.009$) groups were significant predictors at V0 and *Lactobacillus* ($\beta = 0.339$; $p = 0.015$) and the SCFA valeric acid ($\beta = -0.533$; $p = 0.014$) were predictors of calprotectin in V12. For CRP, a trend was found at V12 regression ($p = 0.079$), with significant contributions for the *Blautia coccooides–Eubacterium rectale* group ($\beta = 0.585$; $p = 0.016$) and the categorical binomial variable “Above normal fat mass percentage” (“yes”, “no”) ($\beta = 0.478$; $p < 0.001$). No significant influence of the treatment group was observed. Discussion: Calprotectin levels seem to be dependent on microbiota and SCFA levels. Calprotectin showed a positive and consistent relationship with *Lactobacillus* spp.; however, its relationships with the *Bacteroides* group and valeric acid were not consistent and deserve further exploration. CRP and sIgA do not seem to be explained to a significant level by the microbiota and SCFA concentrations in this prediabetic population.

Keywords: gut microbiota; inflammatory markers; short-chain fatty acids; prediabetes; body fat mass

Author Contributions: Conceptualization, E.N., S.G.-M. and A.M.; methodology, S.G.-M., L.E.D.-P. and E.N.; participant’s interviews and laboratory procedures, S.G.-M., E.N., I.V.-C., L.E.D.-P., N.I. and M.C.M.-R.; formal analysis, E.N. and L.E.D.-P.; writing—original draft preparation, L.E.D.-P. and E.N.; writing—review and editing, all authors; All authors have read and agreed to the published version of the manuscript.

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More Thorough Mastication of Bread May Stimulate Early-Phase Insulin Release: Preliminary Associative Results from a Double-Blind Randomized Controlled Trial [†]

Georgia Chatonidi * , Boushra Dalile and Kristin Verbeke



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Abstract: Background and objectives: Oral processing behavior is suggested to

modulate metabolic responses to foods. In this study, we examined the impact of variations in oral processing characteristics during bread consumption on appetite and postprandial metabolic responses. Methods: Thirty healthy, normal-weight participants consumed three types of bread, differing in the leavening agent, in a randomized cross-over trial, while being video recorded to determine specific oral processing behaviors. At each study visit, gastric emptying, subjective appetites, and glucose and c-peptide levels were measured at regular time points for 4 h. After 4 h, the ad libitum energy intake was measured. The average values of each outcome were calculated to derive a single characteristic value per participant across the three types of bread. Results: A Spearman's correlation analysis showed that the participant age was associated with a faster eating rate ($r = 0.562$, $p = 0.001$), a shorter oral exposure time ($r = -0.569$, $p = 0.001$), and less chews/bites ($r = -0.387$, $p = 0.034$). As expected, a slower eating rate was correlated with more chews per bite ($r = -0.603$, $p < 0.001$). Surprisingly, higher hunger ratings before bread consumption were associated with a smaller bite size ($r = -0.518$, $p = 0.003$). More chews/bites were associated with a higher AUC of C-peptide during the first 30 min after consumption ($r = 0.398$, $p = 0.036$). Oral processing behavior did not correlate with appetite, the energy intake in the subsequent meal, gastric emptying, or the glucose response ($p > 0.05$) to bread. However, slower gastric emptying was associated with a lower glucose

AUC_{30min} ($r = -0.453$, $p = 0.015$) and c-peptide AUC_{30min} ($r = -0.631$, $p < 0.001$). Discussion: Although, overall, the metabolic responses to bread consumption were not affected by oral processing, thorough mastication of bread stimulated the cephalic phase of digestion, resulting in early release of insulin. This is in line with the existing literature, according to which anticipatory sight, smell, and taste of food can initiate the cephalic phase of insulin secretion, which is further enhanced by chewing and swallowing the food. However, the importance of the cephalic phase insulin release in overall glucose regulation is still unclear. Further research is needed to investigate to what extent and according to which mechanisms natural variations in oral processing can affect postprandial metabolic responses to food.

Keywords: oral processing behavior; mastication; appetite; food intake; glycemic response; insulin

Author Contributions: Conceptualization, G.C. and K.V.; methodology, G.C. and K.V.; software, G.C.; validation, G.C., B.D. and K.V.; formal analysis, G.C., B.D. and K.V.; investigation, G.C. and K.V.; resources, K.V.; data curation, G.C., B.D. and K.V.; writing—original draft preparation, G.C.; writing—review and editing, G.C., B.D. and K.V.; visualization, G.C.; supervision, K.V.; project administration, G.C. and K.V.; funding acquisition, K.V. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Association between Dietary Choline and the Incidence of Type 2 Diabetes: Results from a Large Swedish Cohort [†]

Therese Karlsson ^{1,2,*}, Áine Ryan ², Bathsheba Tobin ², Ingegerd Johansson ³  and Anna Winkvist ^{2,4}



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Abstract: Background and Objectives: Type 2 diabetes (T2D) has become a major global issue in the past several decades with a rapidly increasing incidence largely attributable to sedentary lifestyles and westernized diets. Previous research has shown conflicting evidence between dietary choline and the risk of T2D. The present study aimed to investigate associations between dietary choline and its individual forms with the development of T2D. Methods: In total, 41,802 females and 37,952 males attending the Västerbotten Intervention Programme (VIP) between 1990 and 2016 were included. The intake of total choline and its individual forms phosphatidylcholine, glycerophosphocholine, phosphocholine, sphingomyelin and free choline were estimated from a food frequency questionnaire. The associations between dietary choline and T2D were estimated using the Cox proportional hazards regressions to determine hazard ratios (HR) and 95% confidence intervals (CI) for T2D according to total choline, phosphatidylcholine, glycerophosphocholine, phosphocholine, sphingomyelin and free choline intake (quartiles). Models were adjusted for reported energy intake, age, body mass index, education and smoking status. All analyses were performed in females and males separately. Results: During a median follow-up of 16 years, 1195 (2.9%) and 1664 (4.4%) incident T2D cases were registered in females and males, respectively. A higher total choline intake was associated with an increased risk of T2D in both females (HR Q4 vs. Q1: 1.44; 95% CI: 1.11, 1.85; P-trend 0.03) and males (HR Q4 vs. Q1: 1.53; 95% CI: 1.24, 1.90; P-trend < 0.01). Choline intake from phosphatidylcholine and sphingomyelin were positively significantly associated with the risk of T2D in both females and males. No associations were found between choline intake from free choline, phosphocholine or glycerophosphocholine and incidence T2D. Discussion: This study demonstrates an association between the higher intake of total choline and an increased risk of T2DM in females and males in Sweden. The positive association seems to be driven mainly by the intake of choline from phosphatidylcholine and sphingomyelin. This highlights the role of dietary choline intake in relation to T2D and the importance of exploring the impact of the different forms of dietary choline.

Keywords: choline; betaine; type 2 diabetes; prospective cohort; Västerbotten Intervention Program



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Author Conceptualization, T.K. and A.W.; formal analysis, T.K., Á.R. and B.T.; resources, I.J.; writing—original draft

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Data Availability Statement: Data cannot be made freely available as they are subject to secrecy in accordance with the Swedish Public Access to Information and Secrecy Act [Offentlighets- och sekretesslagen, OSL, 2009:400], but can be made available to researchers upon request (subject to a review of secrecy). Requests for data should be made to Anna Winkvist, anna.winkvist@umu.se.

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Association of Unhealthy Lifestyle Score on the Risk of Hypertension, Dyslipidemia, and Their Comorbidity in Korea: A Cross-Sectional Study

†

Ji-Sook Kong and Mi Kyung Kim *



Citation: Kong, J.-S.; Kim, M.K. Association of Unhealthy Lifestyle Score on the Risk of Hypertension, Dyslipidemia, and Their Comorbidity in Korea: A Cross-Sectional Study.

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lifestyle factors play a significant role in the development of hypertension and dyslipidemia. Rather than occurring individually, these conditions often coexist. Therefore, the aim of this study was to investigate the individual and combined effects of lifestyle factors on the risk of hypertension only, dyslipidemia only, and their comorbidity. **Methods:** This study included 9608 adults aged 19 years and above from the cross-sectional Korean National Health Examination Study between 2019 and 2021. An unhealthy lifestyle score was derived from five factors: smoking, alcohol consumption, body mass index (BMI), diet, and physical activity. Each participant was assigned an unhealthy lifestyle score based on the cumulative number of unhealthy factors present. A logistic regression model and multinomial logistic regression were used to estimate odds ratios (ORs) with 95% confidence intervals (95% CIs) after adjusting for confounders. The analysis aimed to assess the association between an unhealthy lifestyle and the risk of hypertension, dyslipidemia, and their comorbidity. **Results:** The prevalence of hypertension only, dyslipidemia only, and their comorbidity was 12.9%, 19.6%, and 16.4%, respectively. In the multivariable model, higher odds of hypertension alone were significantly associated with alcohol consumption and BMI status. Dyslipidemia alone and the comorbidity of hypertension and dyslipidemia were associated with all individual lifestyle factors. When compared to individuals with the highest unhealthy lifestyle score (4–5 scores), those with the lowest score (0–1 scores) had increased ORs of 5.38 (95% CI: 3.15–9.19), 4.08 (95% CI: 2.84–5.85), and 16.0 (95% CI: 9.34–27.5) for hypertension only, dyslipidemia only, and their comorbidity, respectively. Furthermore, even after stratifying by family history, individuals with the lowest lifestyle score were still associated with hypertension, dyslipidemia, and their comorbidity compared to those with the highest lifestyle score, regardless of their family history. **Conclusion:** These findings demonstrate a positive association between unhealthy lifestyle factors and the risk of comorbidity of hypertension and dyslipidemia, as well as hypertension and dyslipidemia alone. Moreover, lifestyle factors may influence the risk of hypertension and dyslipidemia, even in individuals with a family history of these conditions.

Keywords: hypertension; dyslipidemia; comorbidity; smoking; alcohol; BMI

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Short-Term Effects of Crackers on Glycemic Index and Glycemic Responses: A Randomized Clinical Trial in Healthy Adults [†]

Emilia Papakonstantinou ^{1,*}, Vasilis Alsab ¹, Foteini Lympaki ¹, Sofia Chanioti ², Marianna Giannoglou ²
and George Katsaros ²

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Abstract: Introduction: This study aimed to determine the glycemic index (GI)/glycemic load (GL) of three crackers made with different flours. A control cracker (CC), with a 30% w/w substitution of wheat by whole wheat flour (WWC) and with a 30% w/w substitution of wheat by sunflower seed flour (SFC), differing significantly in protein and fiber content, is compared to the reference D-glucose drink. Methods: In a randomized, controlled, crossover design, 11 healthy participants (23.5 (1) years; seven women; BMI 23 (1) kg/m²) were randomly assigned to receive three cracker meals (CC, WWC, and SFC), all containing 50 g of available carbohydrates and 50 g of D-glucose as a reference drink. Results: SFC provided medium GI, low GL values (GI: 56 on glucose scale, GL: 6 per serving), whereas WWC and CC provided high GI, medium GL values (GI: 77 and 90 on glucose scale, respectively; GL: 11 and 12 per serving, respectively). Both SFC and WWC provided lower postprandial glucose concentrations, lower glucose excursions, and lower peak glucose values compared to glucose and CC. All crackers were pleasurable and increased satiety when compared to glucose, without any significant differences between them. Conclusion: SFC and WWC, regardless of soluble fiber and/or protein content, attenuated postprandial glycemic response and improved subjective satiety, which may offer advantages for body weight and glycemic control. This trial was registered at Clinicaltrials.gov: NCT05702372.

Keywords: crackers; sunflower seed flour; whole wheat flour; glycemic index; glycemic responses



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The Importance of Nutritional Status Assessments for Preoperative Bariatric Patients: Correlations between BIA, CRP and Vitamin Status [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023. [‡] Graduated student.

Abstract: Background and Objective: Preoperative assessments of nutritional status are crucial for optimizing outcomes in bariatric surgery patients. Parameters such as bioelectrical impedance analysis (BIA), C-reactive protein (CRP), vitamin D, folic acid and vitamin B12 have been individually studied in relation to nutritional status in bariatric patients. However, a comprehensive understanding of their interrelationships and the importance of a preoperative nutritional status assessment is still needed. The objective of this study is to determine the baseline nutritional status, explore the correlations between BIA, CRP and vitamin status in preoperative bariatric patients, and to assess the significance of nutritional status evaluation before surgery. Methods: Nutritional status, including anthropometric measurements (determined by Tanita, MC-780 MA) and biochemical parameters, were obtained from medical records of 50 adult obese patients who attended a clinic between 2022–2023 and who were advised to have sleeve gastrectomy. A Spearman correlation was used to determine correlation between observed parameters. Results: Most of the patients were women (88%) with an average age of 41 ± 10 years. Their BMI ranged from 39.4 to 63.0 kg/m² and their body fat from 33.9% to 58.5%. The phase angle ranged from 4.6 ° to 7.1 °, while total body water (TBW) for all patients was below 45% for women and 50% for men. A deficiency was observed among 43%, 55% and 20% of patients for folic acid, vitamin D and vitamin B12, respectively. Elevated CRP was present in 73% of patients. A correlation ($p < 0.05$) was found between CRP and BMI ($r = 0.322$), and body fat ($r = 0.488$) and TBW ($r = -0.420$), while 25OH-vitamin D correlated ($p < 0.001$) with the same parameters but the correction was reversed (BMI, $r = -0.424$; body fat $r = -0.662$; TBW $r = 0.525$). Both vitamin B12 and folic acid correlated only with extracellular water ($r = -0.424$ and $r = -0.447$). Discussion: Preoperative sleeve gastrectomy patients with inadequate nutritional status and increased CRP levels made up a significant portion of this population. These findings highlight the need for preoperatively treating dietary deficiencies and inflammation. The long-term effects of preoperative dietary therapy on patient outcomes and general health in the context of bariatric surgery should be the main subject of future study. **Keywords:** bariatric surgery; nutritional status



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Abstract

Can We Use Extracellular Water to Total Body Water Ratio as a Predictor of the Nutritional Status of Patients with Colorectal Cancer at the Time of Diagnosis? †

Mirna Šporčić¹, Irena Martinis¹, Jelena Pugelnik¹, Toni Kolak², Josip Baković², Božica Jerak^{3,†} and

Martina Bituh^{3,*} 



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Abstract: Background and objectives: Early nutritional assessments have the potential to improve prognostic outcomes of patients with colorectal cancer (CRC). Among all parameters measured by bioelectrical impedance analysis (BIA), extracellular water to total body water ratio (ECW/TBW) is a known prognostic factor for various diseases. The objective was to investigate the relationship between the ECW/TBW ratio and the nutritional status of CRC patients at the time of diagnosis. Methods: In this retrospective study, information about the patients' demographic characteristics and nutritional status, including anthropometric measurements (determined by Tanita, MC-780 MA) and biochemical parameters at the time of diagnosis, were obtained from 104 patient records. We divided patients into two groups according to median ECW/TBW ratio (45.25%) and compared the differences between groups using a Chi-square or Mann-Whitney U test. A Spearman correlation was used to determine the correlation between the ECW/TBW ratio and all observed parameters. Results: Groups with a lower ECW/TBW ratio were younger (67 [62.25–72] vs. 74 [65–79] ($p < 0.05$)), had higher body weight (kg) (86 ± 12 vs. 78 ± 13 ($p < 0.001$)), body mass index (kg/m^2) (28.6 ± 3.6 vs. 26.9 ± 4.6 ($p < 0.05$)), phase angle ($^{\circ}\text{PhA}$) (5.7 ± 0.7 vs. 4.6 ± 0.7 ($p < 0.001$)), sarcopenia index ($^{\circ}\text{SMI}$) (8.8 ± 1.2 vs. 7.5 ± 0.7 ($p < 0.001$)), albumin (g/L) (43 ± 3 vs. 41 ± 3 ($p < 0.001$)) and hemoglobin (g/L) (137.50 ± 19.34 vs. 131.00 ± 19.72 ($p < 0.05$)) compared to groups with a higher ECW/TBW ratio. A lower ECW/TBW ratio was predominant in males (75.4%) and among overweight patients ($p < 0.05$). A positive correlation was found between ECW/TBW and age ($r = 0.402$, $p < 0.001$), while negative correlations were observed between ECW/TBW and body weight ($r = -0.408$, $p < 0.001$), SMI ($r = -0.581$, $p < 0.001$), serum albumin ($r = -0.390$, $p < 0.001$), serum hemoglobin ($r = -0.295$, $p < 0.001$) and PhA ($r = -0.703$, $p < 0.001$). Discussion: Analysis indicates that groups with a lower ECW/TBW ratio had overall better nutritional status. Several studies state that abnormal fluid distribution affects prognosis in people with cancer. In our study, patients with a higher ECW/TBW ratio had a much worse degree of cell damage. An ECW/TBW ratio may be useful as an indicator of nutritional status in CRC at the time of diagnosis.

Keywords: colorectal cancer; nutritional assessment; ECW/TBW ratio; phase angle; sarcopenia index

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The Intake of Sucrose but Not of the Intense Sweetener Sucralose Is Associated with Postprandial Endotoxemia in Healthy Young Adults [†]

Raphaela Staltner ^{*}, Anja Baumann and Ina Bergheim



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Abstract: Background and objectives: Similar to saturated fat, a diet rich in sugar may contribute to the development of overweight and obesity and associated metabolic diseases, like type 2 diabetes and metabolic dysfunction associated steatotic liver disease (MASLD). Herein, effects on intestinal microbiota composition and barrier function subsequently leading to an increased translocation of bacterial endotoxin and activation of Toll-like receptor (TLR) 4-dependent signaling cascade are discussed to be critical. In recent years, the use of artificial sweeteners to sweeten food and beverages has markedly increased despite a still limited knowledge on health effects. Results of animal studies suggest that an extended intake of sweeteners like sucralose may alter intestinal microbiota composition and gut barrier function when consumed at high levels. In the present pilot study, we assessed the effects of an acute intake of sucrose and the artificial sweetener sucralose in physiological relevant doses in beverages on postprandial endotoxemia in healthy, normal-weight young adults. Methods: A total of 11 men and women aged 24–31 year were enrolled in this randomized placebo controlled single-blinded study in cross-over design which was approved by the ethics committee of the University of Vienna (Clinical trial: NCT04788680). After an initial blood collection and a 2 day nutritional standardization, according to the recommendations of the German, Austrian and Swiss (DACH) nutritional societies, and a second fasted blood collection, participants consumed either a beverage containing sucrose (110 g), sucralose (180 mg, iso-sweet) or an isocaloric combination of sucralose (180 mg) + maltodextrin (110 g) in a randomized order along with a standardized breakfast. Blood was collected 1, 2 and 3 h after consumption of the beverage. Bacterial endotoxin levels in plasma were measured using LAL assay. Results: After nutritional standardization, bacterial endotoxin levels were significantly lower than before. Furthermore, 2 h after the intake of the sucrose sweetened beverage, bacterial endotoxin levels were significantly higher in plasma compared to baseline levels. A similar increase in bacterial endotoxin levels in plasma was not detected after the intake of the beverage sweetened with sucralose. Discussion: Our data suggest that the intake of a sucrose but not sucralose sweetened beverage results in post-prandial endotoxemia.

Keywords: sucrose; sucralose; intestinal permeability

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Diet Quality Assessment and Lipid Profile of Younger Adult Men with Hypercholesterolemia [†]

Irena Keser ^{1,*}, Sanja Trivunovic ² and Martina Delac ¹



Citation: Keser, I.; Trivunovic, S.; Delac, M. Diet Quality Assessment and Lipid Profile of Younger Adult Men with Hypercholesterolemia. *Proceedings* **2023**, *91*, 258. <https://doi.org/10.3390/proceedings2023091258>

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Abstract: The prevalence of hypercholesterolemia caused by an unhealthy lifestyle is increasing worldwide and is associated with an increased risk of cardiovascular diseases. One of the causes of hypercholesterolemia is an unhealthy diet. The aim of this study was to assess the diet quality by determining the daily intake of energy and nutrients in men with an increased serum concentration of total cholesterol (≥ 5.0 mmol/L) and LDL-cholesterol (≥ 3.0 mmol/L) and to determine whether there is an association between lipid profile and dietary parameters. The participants were males aged 20 to 40 years ($n = 52$). The average daily energy, macronutrient, and micronutrient intake was evaluated using the 24-h recall for two non-consecutive days. The average daily intake of total fat ($39.2 \pm 8.3\%$ kcal) and saturated fatty acids ($13.4 \pm 4.1\%$ kcal) was higher than recommended, and the intake of carbohydrates ($41.7 \pm 9.6\%$ kcal) and fiber (15.6 ± 12.4 g) was insufficient. The average daily intake of sodium and phosphorus was too high, while the intake of potassium, magnesium, and calcium was deficient. The intake of all vitamins, except for vitamin B₃ and vitamin B₆, was also insufficient. The average concentration of HDL-cholesterol in the participants was adequate (1.4 ± 0.2 mmol/L), but the concentration of triglycerides was elevated (1.9 ± 1.3 mmol/L). A statistically significant positive correlation was found between age and triglyceride concentrations ($r = 0.35$; $p < 0.05$). In this study, the influence of energy intake and observed nutrients on the lipid profile was not determined.

Keywords: hypercholesterolemia; diet quality; 24-h recall; lipid profile

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Author Contributions: Conceptualization, I.K. and S.T.; methodology, I.K. and S.T.; software, I.K. and M.D.; formal analysis, I.K., S.T. and M.D.; investigation, S.T.; resources, S.T.; data curation, S.T.; writing—original draft preparation, S.T. and M.D.; writing—review and editing, I.K.; visualization, S.T. and M.D.; supervision, I.K. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: This study was conducted according to the guidelines laid down in the Declaration of Helsinki and was approved by the Ethics Committee of the School of Medicine, University of Zagreb, Croatia. Number of document: 380-59-10106-19-111/106; 641-01/1902/01; Zagreb, 25 April 2019.

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Relevance of High Glycemic Index Breakfast for Heart Rate Variability among Young Students with Early and Late Chronotypes [†]

Bettina Krueger ^{1,*} , Bianca Stutz ¹, Rasmus Jakobsmeier ², Claus Reinsberger ² and Anette Buyken ¹

[†]

Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and Objectives: Previous reports suggest that spikes in plasma glucose affect cardiac autonomic modulation, reflected by a decrease in heart rate variability (HRV). Hence, the hypothesis of this analysis is that cardiac autonomic changes following an early high-glycemic-index (GI) breakfast are more prominent in individuals with later chronotypes than in those with earlier chronotypes because of their unfavorable metabolic situation at this time of the day. Similarly, chronotype-specific morning plasma melatonin levels could be mechanistically relevant for HRV changes following early high-GI breakfasts, as melatonin seems to influence glucose tolerance. Methods: Subjects with earlier (N = 22) and later chronotypes (N = 23) were asked to consume an intervention meal with a GI = 72 in the morning (7 a.m.). Chronotype was assessed by the Munich Chronotype Questionnaire. Plasma melatonin level was determined at approx. 8 a.m. Glucose data were collected by continuous glucose measurement. Blood volume pulses derived by wrist-worn wireless multisensors were used to assess successive interbeat intervals (IBIs). Time domain HRV parameters RMSSD (root mean square of successive differences of normal IBI), mean IBI and SDNN (standard deviation of normal-to-normal IBI) were calculated. Data from 36 participants (n = 21 early and n = 15 late chronotypes) met the following criteria for analysis: beats corrected <10% and effective sample rate > 60 s. HRV differences before vs. after breakfast were calculated and association with chronotype was analyzed by multivariable linear regression. Results: RMSSD, mean IBI and SDNN were higher in both chronotypes before a high-GI breakfast. Changes in the analyzed HRV parameters after a high-GI breakfast did not differ between persons with an earlier or later chronotype (all $p > 0.2$). Pooling the data from both chronotypes, a smaller change in mean IBI following a high-GI breakfast was associated with higher morning plasma melatonin levels ($p = 0.0232$). Neither age, sex nor BMI account for this association. Conclusions: These data suggest that in our very small cohort of young healthy adults, morning plasma melatonin levels, but not chronotype, are associated with parasympathetic HRV activity after an early high-GI breakfast.

Keywords: chronotype; melatonin; heart rate variability; glucose homeostasis; high GI breakfast

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Institutional Review Board Statement: The study protocol was approved by the Ethics Committee of Paderborn University. The trial was registered at clinicaltrials.gov (NCT04298645).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

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Abstract

In Vitro Evaluation of the Effects of Plant-Based Protein Digestates on the Biology and Metabolism of Human Preadipocytes and Adipocytes †

Catherine Lefranc-Millot ^{1,*}, Caroline Perreau ², Marion Bourdens ³, Noémie Juin ³ and Mayoura Keophiphath ³



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Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and Objectives: Excessive deposits of white adipose tissue lead to obesity. Preadipocyte differentiation, adipocyte metabolism, and some inflammatory and profibrotic factors are key in modulating early fat mass expansion and chronic low-grade inflammation and could be targeted to prevent child obesity. Plant-based proteins are being increasingly used, and we evaluated the potential impact on adipose cell biology and the inflammatory processes of some of them, after simulated in vitro gastrointestinal digestion, on (1) the human preadipocyte differentiation, (2) their fibro-inflammatory state, (3) the metabolism of human mature adipocytes, and (4) the beiging potential of two selected digestates on preadipocytes. Methods: (a) Preadipocytes and (b) mature adipocytes isolated from human subcutaneous adipose tissues were treated with eight plant-based protein digestates (PBPDs) and one animal-based protein digestate for (a) 7 to 11 days or (b) 24 h, respectively. We assessed (a) their effects on preadipocytes, in proadipogenic ± proinflammatory conditions, by evaluating cytotoxicity, cell number, lipid droplet accumulation, adiponectin secretion, and UCP1 expression on the one hand, and IL6, CCL2, and fibronectin secretions on the other hand, and

(b) their effects on adipocyte metabolism by studying cytotoxicity, lipolysis activity, and adiponectin secretion. Results: Six PBPDs stimulated adiponectin's secretion by the preadipocytes without affecting their viability and differentiation capacities at the tested doses. Similarly, we observed no cytotoxicity effects on mature adipocytes and a dose-dependent increase in their adiponectin secretion for treatment with five PBPDs. One PBPD modulated the lipolytic activity of adipocytes by decreasing the release of glycerol. In proinflammatory conditions, seven PBPDs reduced the number of preadipocytes, which is abnormally increased with inflammation. Two of them were able to decrease the CCL2 chemokine secretion, and one of them reduced the production of fibronectin, a potential pro-fibrotic protein. Finally, two selected PBPDs were able to increase beige differentiation (UCP1 expression) of preadipocytes cultured in proadipogenic conditions. Discussion: This study revealed potential benefits of plant proteins for obesity prevention, and specifically highlighted the respective properties of pea and oat proteins prototypes: increasing adiponectin secretion and beige differentiation in preadipocytes; decreasing pro-inflammatory and fibrotic molecules secretion by proinflammatory preadipocytes and regulating basal lipolysis and increasing adiponectin secretion by mature adipocytes.

Keywords: plant-based; proteins; preadipocyte; adipocyte; inflammation; beiging; obesity

Author Contributions: Conceptualization, C.L.-M. and M.K.; methodology, M.K. and M.B.; software, D.I.V.A. EXPERTISE.; validation, M.K. and M.B.; formal analysis, M.B. and N.J.; investigation, M.K. and D.I.V.A. Expertise.; resources, D.I.V.A. Expertise.; data curation, D.I.V.A. Expertise; writing—original

draft preparation, C.L.-M., C.P. and M.K.; writing—review and editing, C.L.-M., C.P. and M.K.; visualization, D.I.V.A.; supervision, M.K.; project administration, C.L.-M.; funding acquisition, C.L.-M. and C.P. All authors have read and agreed to the published version of the manuscript.

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Assessment of Adherence to the Mediterranean Diet and Physical Activity Levels in a Group of Italian Celiac Disease Patients [†]

Giorgia Vici * , Laura Malandrino, Debora Giustozzi, Dalia Camilletti , Silvia Zufolino and Valeria Polzonetti



Citation: Vici, G.; Malandrino, L.; Giustozzi, D.; Camilletti, D.; Zufolino, S.; Polzonetti, V. Assessment of Adherence to the Mediterranean Diet and Physical Activity Levels in a Group of Italian Celiac Disease Patients. *Proceedings* **2023**, *91*, 232. <https://doi.org/10.3390/proceedings2023091232>

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Abstract: Background and objectives: The only treatment for celiac disease is a gluten-free diet, but this restriction can lead to nutrient imbalances and a reliance on processed gluten-free products that contain high levels of unhealthy ingredients. A lack of knowledge about naturally gluten-free foods poses challenges for celiac patients. Proper nutrition, based on the principles of the Mediterranean diet, along with regular physical activity, are of fundamental importance to improve overall wellbeing. This study aims to assess adherence to the Mediterranean diet and physical activity levels in adult celiac patients. Methods: This was an observational study carried out on 40 adult celiac patients following a gluten-free diet for at least one year. The level of physical activity was assessed through the International Physical Activity Questionnaire (IPAQ) (short version). The adherence to the Mediterranean diet (MD) was evaluated through the “Medi-Lite” questionnaire. Results: The outcomes unveiled difficulties concerning dietary patterns and adherence to the MD. The mean score for adherence to the MD was 9.3 ± 2.8 , on a scale of 0 to 18, where 0 represents the lowest adherence and 18 the highest. When analysing individual food components, it was found that fruit and vegetable consumption was suboptimal for most, and half of the population lacked sufficient cereal servings per day. The inadequate consumption of legumes, fish, and dairy products was observed, while an excessive intake of meat and cured meats was noted. Furthermore, the analysis of the IPAQ indicated that roughly three-quarters of the population were inactive or minimally active. Discussion: The results show that celiac patients tend to prefer protein foods for safety but have difficulties assessing protein source frequency. Inadequate dairy consumption is common, possibly due to secondary lactose intolerance from reduced lactase production caused by damaged villi. However, with abundant lactose-free products available, increasing milk and dairy consumption is important to prevent deficiencies in calcium, phosphorus, and vitamin D. The findings highlight the challenges celiac individuals face in adhering to a gluten-free diet and making appropriate food choices, leading to inadequate eating habits and nutritional deficiencies. Thus, there is a need for targeted nutritional education interventions to provide precise guidance on safe eating while meeting nutritional requirements for overall well-being, emphasizing the importance of physical activity.

Keywords: celiac disease; gluten-free diet; Mediterranean diet; physical activity; well-being

Author Contributions: Conceptualization, G.V. and V.P.; methodology, G.V. and V.P.; software, D.G.; validation, G.V., L.M. and V.P.; formal analysis, G.V. and L.M.; investigation, G.V., L.M., D.C., S.Z.; resources, V.P.; data curation, G.V. and L.M.; writing—original draft preparation, G.V. and L.M.; writing—review and editing, V.P.; visualization, V.P.; supervision, V.P. All authors have read and agreed to the published version of the manuscript.

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Nutrigenomic Effects of a High-Fat Diet and a Dietary Change to a Low-Fat Diet in the Pancreas in a Mouse Model of Pancreatic Carcinogenesis [†]

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Citation: Krga, I.; Wirkus, J.; Ead, A.S.; Mackenzie, G.G. Nutrigenomic Effects of a High-Fat Diet and a Dietary Change to a Low-Fat Diet in the Pancreas in a Mouse Model of Pancreatic Carcinogenesis. *Proceedings* **2023**, *91*, 222. <https://doi.org/10.3390/proceedings2023091222>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Pancreatic cancer is one of the deadliest cancers, with a 5 year survival rate of around 10% globally. Although

obesity is a modifiable risk factor for this cancer, the role of a high-fat diet (HFD) intake in pancreatic carcinogenesis, the effects of the dietary modification from an HFD to a low-fat diet, and the underlying molecular mechanisms of action are poorly defined. To contribute to understanding these relationships, we assessed the pancreatic global gene expression modulations using an LSLKras^{G12D}/+p48^{Cre/+} (KC) mouse model. Five-week-old mice were fed an HFD (60% energy from fat) or a control diet (11% energy from fat) until 6 months old. In an additional group, the mice consumed an HFD until 3 months old, and then switched to a control diet for 3 months to evaluate the effects of a dietary change to a low-fat diet (DC). Pancreata were collected, RNA was extracted and sequenced, and bioinformatic analysis was performed to identify the biological functions affected by the diets. The HFD significantly modulated the expression of 2166 genes involved in regulating cellular metabolism

(metabolic pathways, oxidative phosphorylation, and pancreatic secretion), cancer-specific functions (pathways in cancer and transcriptional misregulation in cancer), immune function (Th17, Th1, and Th2 cell differentiations) and cell signaling (cytokine–cytokine receptor interaction and chemokine signaling). The DC altered the expression of 988 genes more compared to that of the HFD, presenting an expression profile similar to the control diet. The modulated genes were linked with metabolic processes (pancreatic secretion, fat digestion, and absorption), cell signaling (chemokine signaling, NFκB, and TNF signaling pathways), and cancer-specific functions (proteoglycans in cancer and pathways in cancer). Over 800 genes, mainly linked with metabolic functions, were identified following both DC and HFD intake and presented opposing expression profiles, suggesting that a DC could counteract some nutrigenomic modulations prompted by an HFD. Moreover, this effect was mirrored in the pancreas and final body weights, with the DC mitigating the HFD-induced increases in both the parameters. In summary, we showed the multi-target mode of action of an HFD in the pancreas of KC mice accompanied by increases in pancreatic and body weights that were all neutralized by a 3-month-long switch to a low-fat diet. Further explorations of the possible regulators driving the observed multi-genomic effects are warranted.

Keywords: pancreatic cancer; high-fat diet; nutrigenomics; dietary modifications; low-fat diet

Author Contributions: Conceptualization, J.W., A.S.E., G.G.M., I.K.; investigation and methodology, I.K., J.W., A.S.E., G.G.M.; validation, J.W., A.S.E. and G.G.M.; formal analysis, I.K., J.W.; writing— original draft preparation, I.K.; writing—review and editing, J.W., A.S.E., G.G.M., I.K.; supervision, G.G.M.; project administration and funding acquisition, J.W., G.G.M. All authors have read and agreed to the published version of the manuscript.

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Changes in Gut Microbiota and Serum Metabolites in Patients with Extreme Obesity [†]

Libuša Kubánčová ^{1,2}, Adela Penesová ^{1,2,*} , Ivan Hric ^{1,2} , Jana Babjaková ³ , Eva Baranovičová ⁴, Marián Grendár ⁴ and Viktor Bielik ² 



Citation: Kubánčová, L.; Penesová, A.; Hric, I.; Babjaková, J.; Baranovičová, E.; Grendár, M.; Bielik, V. Changes in Gut Microbiota and Serum

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Abstract: Background and Objectives: In recent years, the crucial role of gut microbiota in the development and regulation of obesity and related metabolic conditions has been increasingly explored. This prospective cross-sectional study aimed to examine the differences in gut microbiota composition and energy metabolites between non-diabetic individuals with extreme obesity (EO) and healthy lean controls (HLC). Methods: A total of 19 non-diabetic participants with EO (average age \pm SD:

35.4 ± 7.0 years, average BMI \pm SD: 48.8 ± 6.7 kg.m⁻²) and 23 HLC participants (average age \pm SD: 31.7 ± 14.8 years, average BMI \pm SD: 22.2 ± 1.7 kg.m⁻²) were investigated. Fecal microbiota was analyzed and classified using specific primers targeting the V1–V3 region of 16S rDNA. Serum metabolites were characterized by nuclear magnetic resonance spectroscopy. Multivariate statistical analysis and Random Forest models were employed to identify predictors with the highest variable importance. Results: A significantly reduced microbial α -diversity; lower relative abundance of beneficial bacterium Akkermansia and SCFA-producing bacteria Eubacterium hallii, Butyrivibrio, Marvinbryantia, and Coprococcus; and increased abundance of pathogenic bacteria Bilophila and Fusobacterium were found in individuals with EO. Interestingly, energy metabolites (citrate and acetate), IR HOMA, and insulin were pinpointed as the most important predictors with exceptional ability to differentiate between EO and HLC participants by the Random Forest machine learning analysis. Conclusion: The findings suggest that changes in gut microbiota and serum acetate and citrate levels in patients with extreme obesity may serve as potential biomarkers for early progression to Type 2 diabetes. Consequently, weight loss interventions and non-invasive manipulation of gut microbiota composition in these patients could offer a novel strategy for managing obesity and related disorders.

Keywords: Gut Microbiota; extreme obesity Type 2 diabetes; energy metabolites

Author Contributions: Conceptualization, A.P. and V.B.; methodology, I.H. and J.B.; software, M.G.; validation, E.B., A.P. and V.B.; formal analysis, L.K.; investigation, L.K.; resources, V.B.; data curation A.P., L.K. and V.B. All authors have read and agreed to the published version of the manuscript.

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The Impact of Replacing Sugar in Sweets by Isomalt on Blood Glucose Management: Evidence from Recent Randomized, Controlled Trials [†]

Lisa Schweitzer * and Stephan Theis



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Abstract: Background and objectives: National authorities

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and WHO recommend limiting consumption of added sugars from different foods. Polyols like isomalt can be used as bulk sweetener and thus help the food industry to replace sugar. Isomalt is a naturally sourced sugar replacer and the only one in its kind made from pure beet sugar. It has low physiological energy value (approximately 8.4 kJ/g), is non-cariogenic, and has low glycaemic properties as well as a very limited effect on insulin response. The present investigation aims to provide evidence from a series of recent randomized human intervention trials in which the respective effects of isomalt as low-digestible carbohydrate replacing sugar in various sweets were tested. Methods: Blood glucose and insulin response of different sweets were tested according to standardized test procedure. The sweets (i.e., chocolate, candies, mints and jam) were provided in realistic portion sizes and either contained sugar or sugar was replaced 1:1 by isomalt. Products were comparable in appearance, taste, and sweetness. 10 healthy adults (mean age: 40.6 ± 7.0 years, BMI: 23.5 ± 3.2 kg/m²) were randomly assigned to consume the sweets in the morning after an overnight fast. Capillary blood samples were taken at baseline up to 180 min to determine blood glucose and insulin levels. Results: Replacing sugar by isomalt led to significantly lower blood glucose response for all products. This was characterized by a significantly reduced incremental glucose peak (iCmax) ranging from –46% to –83% (all $p < 0.05$) and a reduction of the two-hour incremental area under the curve (iAUC2h) by 5% to 71% ($p < 0.05$ for candies, mints and jam). The lower glycaemic profile was accompanied by lower insulin levels. Accordingly, iCmax and iAUC2h following isomalt variants were remarkably reduced by 70 to 92% (all $p < 0.05$) and 58 to 87% (all $p < 0.05$), respectively. Discussion: With a series of RCTs conducted according to international standards in blood glucose response testing, we demonstrate reduced postprandial glycaemic and insulin response to various sweets in which sugar was replaced by isomalt. Hence, using isomalt as a naturally sourced sugar replacer is a viable strategy to support a low glycaemic diet.

Keywords: isomalt; polyol; sugar replacer; glycaemia; insulin; blood glucose management; sweeteners

Author Contributions: Conceptualization, L.S. and S.T.; methodology, L.S. and S.T.; formal analysis, L.S.; investigation, L.S. and S.T.; writing—original draft preparation, L.S.; writing—review and editing, L.S. and S.T.; visualization, L.S. All authors have read and agreed to the published version of the manuscript.

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Nutrition and Movement to Improve Quality of Life with Knee Osteoarthritis—The NUMOQUA Study [†]

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Abstract: Background and Objectives: Osteoarthritis (OA) has long been considered a degenerative disease of cartilage tissue resulting from bodily wear and tear. However, there is accumulating evidence that inflammation plays a key role in the pathogenesis of OA. In knee OA—the most common form of OA—exercise therapy as an effective component of early treatment mainly addresses functional deficits but not the inflammatory processes. In the course of the NUMOQUA project, an anti-inflammatory therapeutic diet named “Austrian OA Cuisine” was developed. It is based on the framework of the New Nordic Diet combined with the food-based dietary guidelines of Austria, the guidelines for OA, the Austrian food culture, and the principles of a sustainable diet. The present study examines the implementation of the “Austrian OA Cuisine” combined with the evidence-based exercise therapy GLA:D[®] (Good Life with osteoArthritis in Denmark) in patients with knee OA and the effects on quality of life, nutritional and inflammatory status, and oxidative stress parameters. Methods: A total of 60 participants aged 50 to 75 with knee OA will be included and randomly assigned either to the intervention group or the control group. All participants will undergo the GLA:D[®] program in the first six weeks. Additionally, the intervention group will receive nutritional group training and individual nutritional counseling on “Austrian OA Cuisine” over nine months. The control group will receive general information about a healthy lifestyle. Measurements at baseline and at four follow-up dates include nutritional, inflammatory, and oxidative stress parameters.

Furthermore, anthropometric and behavioral parameters and clinical data will be assessed. Results:

The recruitment of patients started in the autumn of 2022 and is expected to be completed by January 2024, followed by data collection in January 2025. Discussion: The prevalence of OA is expected to increase in the future due to ongoing demographic changes and rising obesity rates. The expected results will provide important evidence on whether this interdisciplinary therapeutic approach could be a new, cost-effective, and sustainable strategy to address the disease process of OA without negative side effects.

Keywords: osteoarthritis; GLA:D[®]; Austrian osteoarthritis cuisine; nutritional therapy; quality of life

Author Contributions: Conceptualization, B.W., E.H., G.L., O.N., K.-H.W. and S.N.; writing—original draft preparation, S.C.; writing—review and editing, S.C., B.W., E.H., G.L., O.N. and K.-H.W. All authors have read and agreed to the published version of the manuscript.

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Diurnal Differences in Glycaemic Responses to Meals Containing Different Bread Types among Persons at Risk for Type 2 Diabetes—Preliminary Results from a CarbHealth Sub-Study [†]

Alena M. Schadow ¹, Marc Gartner ¹, Bianca Stutz ¹, Bettina Krueger ¹, Jutta Dierkes ² and Anette E. Buyken ^{1,*}



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Abstract: Background and Objectives: Insulin sensitivity has been shown to decrease during the day among persons at risk of type 2 diabetes (T2DM). It remains to be established whether this also results in differences in glycaemic response to meals rich in carbohydrates, e.g., bread meals. Hence, we determined whether diurnal differences between morning and evening meals containing breads could be observed among persons at risk of T2DM consuming different breads as part of their habitual diet. Methods: Analysis based on data from a multicentre randomised controlled trial (CarbHealth) conducted among participants with prediabetes at four study sites (Germany, Norway, Sweden) who received either a β -glucan-enriched bread or a non-enriched wholegrain control bread to replace their habitually consumed bread for 16 weeks. In Paderborn, Germany, participants wore a continuous glucose monitoring device during weeks 1 and 16. The incremental area under the curve (iAUC) in the two hours following a bread meal in the morning or evening was determined and compared using a *t*-test. Morning bread meals were defined as meals consumed between 06.00 and 11.00 a.m., and evening bread meals referred to meals consumed between 05.00 and 10.00 p.m. Results: Out of 47 participants, 20 and 13 who consumed β -glucan-enriched bread or wholegrain bread as part of their meals both in the morning and evening were considered. In persons consuming the β -glucan bread, the iAUC of evening bread meals was higher than in morning bread meals in week 1 only (evening 2 h iAUC = 1561 [\pm 760] mg/dL vs. morning 2 h iAUC = 1181 [\pm 500] mg/dL, *p* = 0.03). In the control bread-group, the iAUC was higher in evening bread meals than in morning bread meals in week 16 (evening 2 h iAUC = 2445 [\pm 1894] mg/dL vs. morning 2 h iAUC = 1764 [\pm 1314] mg/dL, *p* = 0.04). Discussion: These preliminary data from a small sample of persons with prediabetes indicate that diurnal differences in carbohydrate consumption may extend to the context of habitual carbohydrate-rich meals. If replicated, persons at risk of T2DM should be discouraged from consuming large amounts of bread in the evening.

Keywords: glycaemic response; prediabetes; bread

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A Randomised Controlled Trial to Determine the Effect of Unique Grain Fibre-Fortified Bread on Gastrointestinal Symptoms, General Wellbeing and Mental Health of Healthy Adults [†]

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Abstract: Background: High dietary fibre (DF) intake may have beneficial effects on gastrointestinal and brain interactions. Bread is an ideal vehicle to incorporate grain fibre to increase DF content. To date, no studies have explored the association between a habitual intake of bread fortified with unique grain fibre and gastrointestinal symptoms, general wellbeing, and mental health. Objective: To determine whether a four-week intake of bread fortified with unique grain fibre (thrice the amount of DF than control bread) improves subjective gastrointestinal symptoms, general wellbeing, and mental health compared to baseline and white toast (control bread) in healthy adults with low DF intake. Methods: A four-week, two-armed, placebo-controlled, double-blinded, randomised crossover study separated by a two-week washout period was conducted. Fifty-six participants with low DF intake (<18 g/day for females, <22 g/day for males) consumed three (females)/four (males) slices of fortified bread daily for four weeks then control bread and vice versa. Before and after each intervention phase, the participants completed seven self-reported questionnaires: the Gastrointestinal Symptom Rating Scale, Patient-Reported Outcome Measurement Information System-Anxiety and Depression Short Forms 8a, World Health Organisation Well-Being Index, Warwick-Edinburgh Mental Wellbeing

Scales, Multidimensional Fatigue Inventory Short Form, and the Subjective Vitality Scale. Results: Fifty-five participants completed all of the questionnaires before and after each intervention. The preliminary and blinded results showed no significant changes (all $p > 0.05$) in gastrointestinal symptoms, general wellbeing, and mental health following intervention and between interventions. Discussion: With thrice the amount of DF, the unique grain fibre-fortified bread did not cause gastrointestinal symptoms nor did it worsen general wellbeing and mental health in healthy adults with low DF intake. Encouraging the consumption of unique grain fibre-fortified bread could still be an acceptable and effective method to improve DF intake in a healthy adult population with low DF intake. Trial Registration: ACTRN12622000884707.

Keywords: bread; unique grain; dietary fibre; mental health; general wellbeing; gastrointestinal symptoms; randomised controlled trial



Author Contributions: N.C.R.; validation, R.B.G., N.C.R., C.L.W. and S.B.B.; formal analysis, H.M.N., J.M.; investigation, H.M.N., J.M., Conceptualization, R.B.G. and C.L.W., S.B.B., R.B.G. and N.C.R.; data curation, H.M.N., J.M.; writing—original draft preparation, N.C.R.; methodology, R.B.G. and , 195. <https://doi.org/10.3390/proceedings2023091195> , 195

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Institutional Review Board Statement: The study was carried out in accordance with the International Conference of Harmonization Guidelines, national and local requirements, and the Declaration of Helsinki. Ethical approval was sought from the University of Otago Human Ethics Committee for Health (H22/061) and approval was also sought from the University of Otago Christchurch Maori Research Advisor. Prior to commencement, the study was registered at ANZCTR, registration number ACTRN12622000884707.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Written informed consent has been obtained from the patient(s) to publish this paper.

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Consumption of Ultra-Processed Food Is Independently Associated with Premature Mortality in Cancer Survivors: A Prospective Analysis from the Moli-sani Study in Italy [†]

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Abstract: Background and objectives: There is poor knowledge on the role of diet in relation to mortality among cancer survivors. Available studies have mainly focused on diet quality, regardless of food processing, a well-described risk factor in numerous cohorts worldwide. We therefore examined the association of food processing with all-cause mortality in a sample of cancer survivors from the Moli-sani Study (2005–2010, Italy) and analysed biological pathways potentially underpinning these associations. Methods: Longitudinal analysis was performed on 799 men and women (mean age 63 ± 12 y) with a history of cancer at enrolment, followed for 11.8 y (median). Food intake was assessed using a 188-item FFQ. The Nova classification was used to categorize foods according to increasing levels of processing: (1) minimally processed food (e.g., fruits, meat); (2) culinary ingredients (e.g., butter, sugar); (3) processed food (e.g., canned fish, bread); (4) ultra-processed food (UPF; e.g., carbonated drinks, processed meat). We then calculated the proportion (%) of each Nova group on the total weight of food (g/d) by creating a weight ratio. The modified Food Standards Agency Nutrient Profiling System (FSAM-NPS) dietary index was used to assess overall diet quality. Shared biological risk factors for chronic diseases were analysed as potential mediators through change-in-estimate method. Results: In multivariable-adjusted COX analysis controlled for known risk factors and diet quality, a 5% increment of UPF intake in the diet was associated with 14% increased risk of premature mortality (HR = 1.14; 95%CI 1.01–1.29; *p* = 0.03), independent of diet quality; HRs associated with higher intakes of either unprocessed/minimally processed food, or culinary ingredients or processed food were, respectively, 0.94 (0.88–1.01; *p* = 0.10), 0.90 (0.75–1.06; *p* = 0.21 for 1% increment), and 1.02 (0.95–1.09; *p* = 0.56). Serum C-reactive protein levels and resting heart rate accounted together for 58% (*p* value < 0.01) of the association of UPF with mortality. Discussion: In a general adult population, increasing the dietary share of UPF was associated with higher risk of premature death among cancer survivors, independent of diet quality. This association was largely explained by altered levels of inflammation and resting heart rate. Further large cohorts are warranted to possibly confirm these findings and extend knowledge on the biological mechanisms underpinning these associations.

Keywords: ultra-processed food; cancer survivors; all-cause mortality; inflammation; diet quality

Author Contributions: Conceptualization, M.B. and A.D.C.; methodology, M.B. and A.D.C.; validation, S.C.; formal analysis, M.B.; data curation, S.C. and E.R.; writing—original draft preparation, M.B.; writing—review and editing, M.B.D., G.d.G. and L.I.; supervision, G.d.G. and L.I. All authors have read and agreed to the published version of the manuscript.

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The Dietary Inflammatory Index (DII[®]) and Its Correlations with Metabolic Parameters in a Group of Patients with Type 2 Diabetes Mellitus [†]

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Abstract: Inflammation plays a key role in insulin resistance, metabolic syndrome, type 2 diabetes mellitus (T2DM) and cardiovascular risk. Subclinical inflammation has many causes, but diet seems to be a major component in the prognosis of related diseases. In nutritional research methodologies, there has recently been tremendous progress in identifying scores that can assess the inflammatory traits of diet. One of these scores is the Dietary Inflammatory Index (DII[®]). The aim of this study was to evaluate dietary intake and calculate the DII[®] in a group of patients with type 2 diabetes and correlate it with other metabolic parameters. **Methods.** We evaluated a group of patients with T2DM who presented for their routine checkup in our clinic. We assessed each patient’s anthropometric and metabolic parameters and evaluated dietary intake using EPIC FFQ, which was later interpreted using FETA. We calculated the DII[®] using the validated formula. **Results.** Our study was conducted on 263 patients with type 2 diabetes mellitus, among which 108 were men (41.1%). The average age in the studied population was 62.46 ± 9.45 years, without significant differences between men and women. Only 16 patients (6.1%) were of normal weight, 86 were overweight (32.7%) and 161 presented as obese (61.2%). Men in our study group showed a significantly higher DII score than women, and they also had significantly worse metabolic parameters. The DII correlated with weight and body fat percentage. **Conclusions.** The DII showed a relatively high proinflammatory diet in patients with T2DM studied and found that men were more exposed to diet inflammation than women. This might suggest that nutritional interventions in patients with T2DM should be targeted particularly to this group of patients.

Keywords: Dietary Inflammatory Index; DII; type 2 diabetes mellitus

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Effects of Omega-3 Fatty Acid Supplementation on Revascularization and Major Cardiovascular Events: A Systematic Review and Meta-Analysis [†]

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Abstract: Background and Objectives: The clinical benefits of omega-3 fatty acid (FA) supplementation in preventing and treating cardiovascular disease remain controversial. The aim of this study was to investigate the effects of omega-3 FA administration on revascularization and adverse cardiovascular events including myocardial infarction, stroke, unstable angina, heart failure, and cardiovascular events/mortality using a meta-analytical approach. Methods: A comprehensive search of MEDLINE, Embase, Scopus, Web of Science, and Cochrane Library was performed throughout January 2023. Randomized controlled trials (RCTs) including at least 500 participants that compared the effects of omega-3 FA formulations (eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), or the combination) versus placebo or standard of care controls were considered eligible. Results: Our analysis included 17 RCTs that enrolled a total of 131,686 participants randomized to combined EPA + DHA ($n = 52,498$), EPA alone ($n = 13,415$), and control ($n = 65,771$). Overall, omega-3 FA supplementation was associated with reduced risk of revascularization [RR 0.91, 95% CI 0.84–0.99; $p_{het} = 0.0002$; $I^2 = 69\%$; $p = 0.02$] and myocardial infarction [0.89, 95% CI 0.80–0.98; $p_{het} = 0.04$; $I^2 = 45\%$; $p = 0.02$] compared to controls, but had no significant effects on stroke, unstable angina, heart failure, or cardiovascular events/mortality. Comparing combined EPA + DHA with EPA, EPA alone was associated with a greater reduced risk of revascularization [0.76, 95% CI 0.63–0.94] and myocardial infarction [0.72, 95% CI 0.62–0.83], and a significantly reduced risk of stroke [0.72, 95% CI 0.55–0.95] and unstable angina [0.73, 95%



CI 0.62–0.85]. No significant differences were observed according to EPA + DHA dose, EPA dose, and statin use. Conclusions: Omega-3 FA supplementation was associated with a reduced risk of revascularization and myocardial infarction compared with controls. The use of EPA alone appeared to be associated with even greater benefits, but further high-quality studies are

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needed to clarify the role of omega-3 FA supplementation in the primary and secondary prevention of cardiovascular disease.

Keywords: omega-3; revascularization; cardiovascular disease; meta-analysis

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Spirulina's Effect on Paraoxonase Activity [†]

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Abstract: Hyperlipidaemia is a common worldwide problem associated with an increased risk of coronary and extra-coronary atherosclerosis and cardiovascular disease. Besides changes in lifestyle habits that include controlling the diet with moderate alcohol consumption and maintaining normal weight, medication is usually prescribed in addition. The antioxidative potential of functional food in the treatment of hyperlipidaemia continuously attracts growing attention. Paraoxonase enzyme (PON1) prevents the oxidation of low- and high-density lipoprotein (LDL and HDL) and, hence, has an important role in acting against lipid peroxides. The aim of this study was to evaluate *Spirulina platensis*'s influence on blood and hepatic PON1 activity in an animal model. Male Wistar rats (approved by the Institutional Bioethics committee No. III-2011-01) were randomly divided into five groups based on the applied diet (I—normal diet; II—normal diet with spirulina; III—lipogenic diet; IV—lipogenic diet with concomitant spirulina supplementation; and V—lipogenic diet with spirulina treatment). The differences in PON1 activity were related to diet type. A lipogenic diet rich in saturated fats impaired the PON1 activity. Both blood and hepatic PON1 activity were significantly increased after the administration of a normal diet with spirulina supplementation. As expected, significantly reduced blood PON1 activity was measured in the lipogenic diet group. Blood PON1 activity was decreased in groups III, IV, and V, but PON1 in both the blood and liver had a tendency to increase in groups IV and V. Based on the obtained results, PON1 activity is affected by hyperlipidaemia, and spirulina supplementation may promote enzyme activity.

Keywords: functional food; hyperlipidaemia; antioxidative potential



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Author Contributions:

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Long-Term Sunflower Oil Diet Effects on Mouse Brain Lipid Metabolism [†]

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Abstract: Background and Objectives: Fatty acids play an important role in many physiological processes in different organs. Their effect is well documented in neurodegenerative diseases and inflammatory diseases. Also, the brain as an organ is known to be enriched by docosahexaenoic acid (DHA) and arachidonic acid (AA). However, there are not many studies showing the effect of long-term oil diets on brain lipid metabolism. The aim of this study was to investigate the effects of dietary sunflower oil (enriched with oleic acid, GA-ME-HA, Sarajevo, Bosnia and Hercegovina) on fatty acid profiles in the brain after 100 days of treatment. Methods: Six-week-old adult female C57BL/6 mice were used in these experiments. A total of 20 laboratory female C57BL/6 mice were randomly divided into two groups, the control (n = 10) and sunflower diet treatment groups (n = 10), enriched with 25% saturated/unsaturated fats in isocaloric diet conditions. Mice were obtained from the vivarium (Galenika a.d. Belgrade, Serbia) and housed at four or five animals per cage under identical and controlled conditions (temperature 22 ± 1 °C, humidity 65 ± 1%, 12 h circadian rhythm). Fatty acid ester analysis was performed by gas–liquid chromatography (Shimadzu, Kyoto, Japan) and presented as percentages of overall 100% fatty acids identified. Results: Our results showed that a sunflower oil diet increases DHA ($p < 0.05$) as well as arachidonic acid (AA) ($p < 0.05$). There was also a trend of increasing linoleic acid (LA), but it was not significant. Our future studies would perform more investigations.

Keywords: the brain; phospholipids; fatty acids; sunflower oil; C57BL/6 mice

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Author Contributions: S.R., T.P. and J.D.M. have written the manuscript. T.P., A.N., J.D.M., S.R. and S.K. have conducted experiments. J.M. and A.T. have supervised the work. A.N. and T.P. have performed statistical analyses. All authors have been involved in interpreting the results, contributed to drafting the discussion, and approved the final version of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Plant Dominant Low-Protein Diet, Nutritional Status (Phase Angle) and Progression of Renal Failure: Case-Report Study [†]

Danijela Ristic-Medic * , Snjezana Petrovic, Biljana Pokimica, Marija Paunovic and Vesna Vucic



Citation: Ristic-Medic, D.; Petrovic, S.; Pokimica, B.; Paunovic, M.; Vucic, V. Plant Dominant Low-Protein Diet, Nutritional Status (Phase Angle) and Progression of Renal Failure: Case-Report Study. *Proceedings* **2023**, *91*, 197. <https://doi.org/10.3390/proceedings2023091197>

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Abstract: Background and Objectives: High dietary protein intake can cause intraglomerular hypertension, which may result in kidney hyperfiltration, glomerular injury, and proteinuria. The quality of dietary protein may also play a role in kidney health. Several observational studies have shown that compared with protein from plant sources, animal protein is associated with an increased risk of end-stage chronic kidney disease (CKD). A plant dominant low-protein diet composed of $\geq 50\%$ plant-based sources may lead to favorable changes in the gut microbiome, which can modulate uremic toxin generation and slow CKD progression, along with a reduction in cardiovascular risk. Phase angle (PhA) as a nutritional evaluation parameter is a reliable marker for estimating muscle health and quality of life scale in CKD patients. We evaluated the effect of a calorie restrictive plant dominant low-protein diet (PLADO) on the progression of renal failure and nutrition status in the patient case report. Methods: A 68-year-old female, obese (BMI 31.9 kg/m²) with CKD grades 3 presented to her primary care physicians in October 2022, changed her diet from an unhealthy Western diet to a personalized PLADO (protein 0.6–0.8 g/kg/day), caloric-restricted diet rich in fiber, according to basal metabolic rate (energy intake 1400 kcal/day) prescribed by a dietitian doctor. Liver and thyroid function and ferritin and potassium levels were within normal limits. Habitual dietary intake was estimated with a food frequency questionnaire and their body composition, and PhA was measured using a bioimpedance analysis (InBody 770; Seoul, Republic of Korea). The optimal PhA cut-off value was identified as ≤ 4.4 for non-dialysis patients. Results: After 3 months, serum urea, creatinine, uric acid, and glucose levels were significantly reduced, and hematological parameters and potassium levels were not significantly different. BMI, visceral fat, and total body fat % decreased, while PhA and skeletal muscle mass were stable. Conclusions: We confirmed that the PLADO diet with $\geq 50\%$ plant protein can be safely recommended to patients with stage 3 CKD, as it slows down the progression of renal failure, and does not lead to a reduction in PhA. Therefore, there is a need for nephrology to include nutritional management of kidney disease in addition to the pharmacological axis.

Keywords: chronic kidney disease; low protein diet; phase angle; PLADO diet

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Author Contributions: Case study design, D.R.-M. and B.P.; conducting study visits, D.R.-M. and S.P.; statistical analysis, M.P.; data interpretation, D.R.-M. and S.P.; writing- original draft preparation, D.R.-M.; writing- review and editing, V.V.; All authors contributed to the manuscript and approved the submitted version. All authors have read and agreed to the published version of the manuscript.

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Abstract

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Abstract

The Effect of Cr(III) Supplementation in Combination with Diversified Zn Content in the Diet on the Cr Status in Wistar Rats [†]

Halina Staniek *, Ewelina Król and Zbigniew Krejpcio



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Abstract: Both Zn and Cr(III) independently show similar, beneficial effects on metabolic parameters, including carbohydrate and lipid metabolism particularly in patients with diabetes. However, the knowledge about the combined effect of Cr(III) supplementation in Zn

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homeostasis disorders is insufficient. The aim of the study was to investigate the effect of chromium(III) supplementation in combination with diversified Zn content in the diet on the tissual Cr levels in healthy Wistar rats (male and female). The model studies were carried out on 72 (36♀ + 36♂) Wistar rats, which were divided into 12 groups (6 animals separately for each sex) and then fed ad libitum with 6 test diets for 6 weeks. The control groups (C) were fed a semi-synthetic AIN-93 diet with recommended levels of Zn (35 mg/kg) and Cr(III) (1 mg/kg) for rodents. The other groups were fed AIN-93 diets modified for Zn(II) content (D-Zn deficiency-5% RDA, OS-Zn oversupply-500% RDA). At the same time, the diets were supplemented with Cr(III) at doses of 1 and 50 mg/kg. The sources of Zn and Cr(III) were Zn(II) carbonate and Cr(III) propionate (Cr3), respectively. The tissular chromium levels were measured with the GF-AAS method. It was found that the Cr(III) supplementation as well as the varied Zn supply independently and in combination affected the hepatic and renal Cr contents in rats. Independently, Cr(III) supplementation increased the Cr levels in the liver and kidneys in both sexes. However, with the increase of the Zn supply in the diet decreased the renal Cr content in male (significantly) and female (insignificantly) rats. Both Zn deficiency and oversupply increased the Cr saturation in the liver in both sexes. A significant combined effect of the factors on the liver and kidney Cr content only in male rats was observed. The simultaneous Cr(III) supplementation significantly increased the liver Cr content with the recommended (by 68%) and excess (153%), but not deficient Zn supply in the diet. The research proved that the diversified Zn content in the diet, individually and in combination with Cr(III) supplementation affected the Cr status in healthy rats.

Keywords: chromium(III); zinc; deficiency; supplementation; rats

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Investigation of the Postprandial Glycaemic Response to White Bread and Wholemeal Bread Consumption among Healthy Young Adults [†]

Honglin Dong ^{1,*} , Diana Galindo Pineda ², Ni Li ² and Yizhi Xu ²



Keywords: postprandial glycaemic response; fasting glucose; dietary fibre; bread

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Background and Objectives: Wholemeal bread is regarded as healthier than white bread due to its higher fibre contents and other nutrients, including phytochemicals and essential minerals, and is recommended to be included in the healthy diet over white bread [1]. This study aimed to investigate the difference in the postprandial glycaemic response to commonly consumed white bread and wholemeal bread in the UK in normal weight and healthy young adults. **Methods:** Designed as an acute randomized cross-over trial, 20 participants (10 white Caucasians and 10 Chinese, 20–31 y, BMI 18.5–24.6 kg/m²) were given two slices of wholemeal (fibre 6.7 g) and white bread (fibre 2.7 g) alongside 150 mL of pure orange juice and 10 g of butter on separate visits randomly (minimum of a 48-h interval) after fasting for 12 h. The blood glucose concentration was measured at time 0 (fasting), 30 min, 60 min, 90 min and 120 min postprandially through multiple finger pricks using a Biosen blood glucose analyser. The difference in the area under the curve (AUC) and the peak value (PV) between different bread intakes were analysed through a paired *t*-test and between groups (genders, ethnicities) using two-way repeated measures ANOVA. **Results:** Characteristics of the participants were as follows: age: 23.15 ± 3.3 y; body mass index (BMI): 21.0 ± 2.2 kg/m²; body fat composition: 19.9 ± 6.3%. The AUCs were significantly reduced after wholemeal bread meal consumption compared with white bread meal consumption (631.9 ± 66.8 mmol·min/L vs. 655.8 ± 56.6 mmol·min/L, *p* = 0.027). The AUCs were significantly less in females compared with males after both instances of bread meal consumption (white bread: female 630.2 ± 54.7 mmol·min/L, male 676.7 ± 51.2 mmol·min/L; wholemeal bread: female 593.7 ± 49.7 mmol·min/L, male 663.0 ± 64.2 mmol·min/L, *p* = 0.024). There was no significant difference in the PVs between the genders. No difference in either the AUCs or PVs was observed between ethnic groups, though Chinese participants had significant lower fasting blood glucose levels than their counterparts. **Discussion:** The wholemeal bread did deliver a beneficial effect for the postprandial glycaemic response compared with white bread consumption. Female participants show significant lower postprandial glycaemic response than males regardless of white or whole meal bread consumption.

Author Contributions: Conceptualization, H.D. and Y.X.; methodology, H.D. and Y.X.; investigation, D.G.P. and N.L.; data analysis, H.D. and Y.X.; writing—original draft preparation, H.D.; writing—review and editing, Y.X.;

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Gut Microbiome Composition Associated with Body Weight in People with Type 1 Diabetes and Related to Dietary Factors [†]

Giuseppe Scidà ^{1,*} , Alessandra Corrado ¹ , Jumana Abuqwider ¹, Giuseppina Costabile ¹ ,Francesca De Filippis ² , Danilo Ercolini ² and Lutgarda Bozzetto ¹ 

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Abstract: Background and Objectives: The gut microbiome composition has emerged as a potential contributor to metabolic health and it is influenced by several factors, such as dietary factors. Individuals with type 1 diabetes (T1D) experience metabolic dysregulation, including alterations in body weight; as a result, the prevalence of overweight/obesity is increasing in this population. Limited research has addressed the role of the gut microbiota on body weight in people with T1D. Our aim is to evaluate the association between BMI and gut microbiome composition in T1D patients, also exploring the relationship between dietary factors and the microbiota. Methods: A cross-sectional study was conducted involving T1D patients ($n = 101$) of both sexes, aged 18–79 years. Anthropometric parameters were measured, and the European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire was administered to evaluate dietary habits. Patients collected stool samples that were analyzed by shotgun metagenomics sequencing for the evaluation of the gut microbiota composition. Associations between BMI, gut microbiome composition, and dietary factors were evaluated by Pearson's bivariate correlation. Results: BMI was correlated inversely with the Bacilli ($r = -0.296$, $p = 0.004$) and Gammaproteobacteria ($r = -0.280$, $p = 0.009$) classes and directly with the abundance of the Clostridia class ($r = 0.220$, $p = 0.031$) and one of its species *Faecalibacterium prausnitzii* ($r = 0.264$, $p = 0.010$). The presence of these taxa was associated with dietary factors: Bacilli was inversely correlated with the consumption of animal protein ($r = -0.242$, $p = 0.019$), monounsaturated fatty acids ($r = -0.214$, $p = 0.038$), linolenic acid ($r = -0.236$, $p = 0.022$), oleic acid ($r = -0.205$, $p = 0.048$), and cholesterol ($r = -0.204$, $p = 0.048$); *Faecalibacterium prausnitzii* was directly associated with the intake of cholesterol ($r = 0.218$, $p = 0.034$) and simple sugars ($r = 0.226$, $p = 0.028$). Clostridia was correlated directly ($r = 0.225$, $p = 0.027$) and Gammaproteobacteria inversely ($r = -0.216$, $p = 0.045$) with alcohol intake. Discussion: BMI was associated with the Clostridia, Bacilli, and Gammaproteobacteria classes. These bacteria were related to various dietary factors. Therefore, changes in the gut microbiota could be a possible link between dietary habits and overweight/obesity in people with T1D.

Keywords: gut microbiome; body weight; dietary factors; type 1 diabetes

Author Contributions: Conceptualization, L.B. and G.S.; validation, L.B. and G.C. and D.E.; formal analysis, G.S. and A.C. and J.A.; investigation, G.S. and A.C.; data curation, G.S. and A.C. and J.A.; writing—original draft preparation, G.S. and L.B.; writing—review and editing L.B. and F.D.F.; supervision, L.B. and D.E.; funding acquisition, L.B. All authors have read and agreed to the published version of the manuscript.

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Gut Microbiome Composition Is Associated with Blood Glucose Control and Dietary Intake in People with Type 1 Diabetes [†]

Jumana Abuqwider ^{1,*}, Giuseppe Scidà ¹ , Alessandra Corrado ¹ , Giuseppina Costabile ¹ , Francesca De Filippis ² , Danilo Ercolini ² and Lutgarda Bozzetto ¹



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Abstract: Background: Blood glucose control remains a challenge for type 1 diabetes (T1D) patients. Previous studies have shown an association between gut microbiota composition and T1D pathogenesis. However, little is known about the composition of the gut microbiota and its association with host blood glucose control and diet in people with T1D. Objective: We explored the relationship of gut microbiome composition with blood glucose control and dietary intake in people with T1D. Research design and methods: In a cross-sectional study, a metagenomic shotgun sequencing analysis of the gut microbiome obtained from fecal samples was performed in 101 individuals with T1D. Dietary intakes were assessed by using the European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire. Blood glucose control was assessed by continuous glucose monitoring and expressed as time-in-range (TIR), time spent in the blood glucose interval 70–180 mg/dL. Spearman's correlation analysis was used to determine the correlation between gut microbiota composition, blood glucose control, and dietary intake. Results: TIR correlated positively with the abundance of Bacilli ($r = 0.258$, $p = 0.027$) and negatively with the Lachnospiraceae family ($r = -0.238$, $p = 0.024$), *Mediterraneibacter* ($r = -0.249$, $p = 0.034$), *Coprococcus* genus ($r = -0.286$, $p = 0.016$), *Coprococcus comes* ($r = -0.257$, $p = 0.028$), and *Ruminococcus torques* ($r = -0.261$, $p = 0.026$). The presence of these taxa was associated with the intake of various foods: Bacilli correlated positively with dairy products ($r = 0.307$, $p = 0.002$) and negatively with olive oil ($r = -0.207$, $p = 0.041$) and meat products ($r = -0.255$, $p = 0.012$). Lachnospiraceae correlated negatively with cereals ($r = -0.263$, $p = 0.009$). *Mediterraneibacter* correlated positively with meat and meat products ($r = 0.230$, $p = 0.023$). *Ruminococcus torques* correlated negatively with fruit intake ($r = -0.227$, $p = 0.025$). Discussion: Our findings highlight that gut microbiota composition may be related to blood glucose control in T1D and dietary factors may have a role in this interplay. Further investigations are needed to address whether these findings are causally linked and whether to target these gut microbiota taxa.

Keywords: gut microbiome; glycemia; time-in-range; diet

Author Contributions: Conceptualization, J.A. and L.B.; validation, J.A., L.B., G.C. and D.E.; formal analysis, J.A., A.C. and G.S.; investigation, J.A. and A.C.; data curation, J.A., A.C. and G.S.; writing— original draft preparation, J.A. and L.B.; writing—review and editing L.B. and F.D.F.; supervision, L.B. and D.E.; funding acquisition, L.B. All authors have read and agreed to the published version of the manuscript.

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Nutrition as a Part of Lifestyle Medicine Interventions [†]

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Abstract: Background and Objectives: The epidemic of non-communicable diseases (NCDs) affects the lives of millions of people around the globe. It poses devastating health consequences for individuals, families and communities, threatening to overwhelm health systems. Non-communicable diseases, including heart disease, stroke, cancer, diabetes and chronic lung disease, are jointly responsible for around 75% of all deaths worldwide. The major NCD risk factors are modifiable behaviors such as tobacco use, unhealthy diet, physical inactivity and alcohol abuse. The European Commission has estimated that health promotion and disease prevention strategies can reduce the burden of NCDs by up to 70%. Taking this into consideration, the imperative approach to reducing the spread of NCDs is to control related risk factors. Methods: A literature review was performed by using major search engines such as Google Scholar, PubMed and ScienceDirect. The keywords used in the search were ‘nutrition’, ‘lifestyle interventions’, and ‘NCD’. The collected information was then critically assessed. Results and discussion: Lifestyle medicine (LM) is a branch of medicine focused on preventive healthcare and self-care dealing with the prevention, education, research and treatment of disorders caused by lifestyle factors. It aims to improve individuals’ health and quality of life through the six pillars of LM: nutrition, physical activity, sleep, stress management, avoidance of risky substances and positive social connection. Multiple studies have demonstrated that a lifestyle incorporating health-promoting practices profoundly impacts health and quality of life. The rising reputation of lifestyle medicine interventions can be attributed to their effectiveness in managing chronic conditions such as type 2 diabetes, metabolic syndrome, cardiovascular disease and obesity. Nutrition is one of the leading lifestyle modification factors with an impact on health status. An appropriate diet could reduce NCD risk and increase life expectancy due to different mechanisms, including effects on the immune system, gut microbiome modulation, anti-inflammatory properties, and others. Nutrition in particular plays a prominent role in LM interventions as it is essential to promoting health and preventing or even reversing disease. It is an integral part of LM interventions and is critical for the success of any LM program.

Keywords: lifestyle interventions; nutrition; non-communicable diseases; NCD prevention

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Association between the Postprandial Glucose and Insulin Response and Changes in Anthropometric Parameters after an 8-Week Formula Diet—Data from the Lifestyle Intervention Study [†]

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Abstract: Background and Objectives: There is a high inter-individual variability in the postprandial response to an oral glucose tolerance test (OGTT). However, there is limited evidence on whether the individual postprandial response is associated with the success of a weight management intervention. This work examines postprandial glucose and insulin response to an OGTT as predictors for changes in anthropometric parameters after a standardized weight loss intervention. Methods: Adults (18–65 years) with a body mass index (BMI) between 30.0 and 39.9 kg/m² were recruited for the Lifestyle Intervention (LION) study (NCT04023942). Blood samples were taken before the start of the 8-week formula diet and during an OGTT. Several parameters describing the postprandial glucose and insulin response (e.g., area under the curve, peak time, and concentration) were calculated. Anthropometric parameters (e.g., body weight, fat mass) were collected before and after the 8-week formula diet. Finally, regression analyses adjusted for age and sex were fitted. Results: A total of 272 participants (mean age 45 ± 11 years, BMI 34.5 ± 2.9 kg/m², 64% women) were included in the analysis. The formula diet resulted in an average weight loss of 11.8 ± 3.5 kg body weight and 8.2 ± 2.5 kg (4.1 ± 2.2%) fat mass. Postprandial parameters describing the glucose or insulin response from a total of 161 OGTTs showed no significant associations with changes in anthropometric parameters. Discussion: The examined postprandial glucose or insulin responses are not associated with weight loss success after an 8-week formula diet.

Keywords: postprandial response; metabolism; weight loss; lifestyle intervention; personalized nutrition

Author Contributions: Conceptualization, A.R., G.S. and C.H.; methodology, A.R. and C.H.; formal analysis, A.R. and G.S.; investigation, A.R., G.S., H.H. and C.H.; data curation, A.R.; writing—original draft preparation, A.R.; writing—review and editing, A.R., G.S., M.W., H.H. and C.H.; visualization, A.R. and G.S.; supervision, C.H.; project administration, A.R., M.W.; funding acquisition, C.H. All authors have read and agreed to the published version of the manuscript.

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Synergistic Effect of Oat Polar Lipids and Oat Beta-Glucans on Postprandial Blood Glucose: A Randomized Controlled Crossover Study in Healthy Subjects [†]

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Keywords: oat; oat polar lipids; oat beta-glucan; postprandial glycaemic response; satiety



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Background/Aim: The identification and development of high-quality, healthy foods are needed to help prevent metabolic diseases such as obesity and type 2 diabetes. The intake of oat beta-glucans (OBGs) at a dose of 4 g per 30 g of available carbohydrates decreases the postprandial glycemic response and has the potential to increase perceived satiety. The intake of oat polar lipids (OPLs) has been shown to improve cardiometabolic markers in healthy subjects [1]. This study aimed to investigate the possible synergistic effects of OBGs and OPLs on postprandial glucose metabolism and subjective appetite variables. **Methods:** One control (plain white wheat bread (WWB)) and four test products were included. The test products consisted of WWB supplemented with (a) 2 g or (b) 4 g of OBGs per 30 g of available carbohydrates, (c) WWB + 4 g of OPLs, and (d) WWB + 2 g of OBGs (as above) + 4 g of OPLs. The OPLs were provided as a spread on the bread slices. Each breakfast contained a total amount of 50 g of available carbohydrates. Blood samples for glucose measurements were collected in a fasting state and at regular time points for 3 h after the consumption of each breakfast. Subjective appetite-related parameters were measured using a visual analogue scale. **Results:** Twenty healthy, young volunteers (24 ± 2 years of age) with a normal BMI (22.9 ± 1.9 kg/m²) completed this randomized controlled crossover study. Postprandial blood glucose responses (iAUC, 0–180 min) were significantly decreased after the intake of WWB + 4 g of OBGs (124 ± 10 mmol.min/L) and WWB + 2 g of OBGs + 4 g of OPLs (130 ± 9 mmol.min/L) compared to the WWB control (198 ± 21 mmol.min/L) ($p < 0.05$). No significant glucose-lowering effect was observed after an intake of the WWB + 2 g of OBGs (162 ± 16 mmol.min/L) or WWB + 4 g of OPLs (141 ± 15 mmol.min/L) compared to the WWB control. Subjective satiety tended to decrease after the intake of the breakfast containing 4 g of OBGs compared to the control breakfast. **Conclusion:** We conclude that a low dose of OBGs (2 g) ingested together with 4 g of OPLs has a



blood-glucose-lowering effect, and this effect is of the same extent as 4 g of OBGs, i.e., no synergy effect was observed.

Author Contributions: Conceptualization, L.C., A.N. and J.T.; methodology, M.M.H. and W.D.; software, W.D.; validation, M.M.H. and W.D.; formal analysis, W.D.; investigation, M.M.H. and W.D.; writing—original draft preparation, L.C. and W.D.; writing—review and editing, L.C., M.M.H., J.T. and A.N.; visualization, L.C.; supervision, L.C, J.T. and A.N.; project administration, L.C. and A.N. All authors have read and agreed to the published version of the manuscript.

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Selecting Type of Grain and Bigger Particle Size to Modulate Starch Digestibility and Glycemic Response [†]

Alexandra Meynier * , Isabel Moreira De Almeida and Sophie Vinoy



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particle size and grain integrity may influence the availability of nutrients and their metabolic impact. We studied the impact of different grains with bigger particle sizes than flours on starch digestibility and glycemic and insulinemic indexes in humans. **Methods:** Moist biscuits, containing 40% of intact grains of quinoa, millet, teff, fonio, or buckwheat grits, and a control made with wheat flour, were produced. Starch digestibility of the final products was analysed according to the Englyst method after two preparation methods: mincing, which led to conditions close to mastication or milling, which led to sample pulverization. Glycemic and insulinemic indexes (GI; II) and response parameters following consumption of these products were evaluated in humans. Product portions provided 50 g of available carbohydrates. The study was performed on 19 healthy normal-weight subjects who tested all six moist biscuits according to a cross-over design. **Results:** Starch digestibility analyses in minced products showed low Slowly Digestible Starch (SDS) content in control, high SDS content in buckwheat biscuits, high SDS and resistant starch (RS) contents in quinoa and fonio, and high RS in teff and millet products. When analysing milled samples, SDS and RS decreased in buckwheat and quinoa biscuits. RS decreased and SDS increased in teff and millet, and the values remained similar to minced samples for fonio biscuits. GI values for the products were 60 ± 7 for quinoa, 55 ± 7 for millet, 52 ± 7 for control and buckwheat, 41 ± 9 for teff, and 39 ± 5 for fonio biscuits. Teff and fonio biscuits led to lower glycemic responses compared to the other products. Insulin responses were related to the glycemic responses. **Conclusions:** The type of grains and the use of intact grains strongly impact starch digestibility, allowing for the modulation of glycemic and insulinemic responses. Using different types of grains to wheat and different particle sizes would allow for the modulation of glucose metabolism and potentially lead to long-term beneficial health effects.

Keywords: grains; particle size; starch digestibility; glycemic response

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Abstract: Context and Objectives: Cereals and pseudo-cereals show a variety in terms of shape and color but also nutrition composition and starch structure. Altering

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Adherence to the WCRF/AICR Cancer Prevention Recommendations and All-Cause Mortality among Cancer Survivors from the Moli-sani Study Cohort [†]

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Abstract: Background and objectives: The guidelines provided by the World Cancer Research Fund/American Institute of Cancer Research (WCRF/AICR) aim to reduce the risk of developing cancers worldwide. The WCRF/AICR advises cancer survivors to follow the same recommendations for cancer primary prevention. These recommendations have been operationalized into a quantitative index based on a total of seven or eight healthy lifestyles; the points-based system allows for scoring a full point and, in some cases, partially meeting a recommendation. Evidence of the usefulness of the WCRF/AICR recommendations in populations different from those in the US is scarce. The aim of the present study was to assess whether compliance with the 2018 WCRF/AICR recommendations for cancer prevention is related to all-cause mortality among cancer survivors recruited in the Molisani Study cohort in Italy (2005–2010). Methods: A longitudinal analysis of 786 participants (59.7% women) with a history of cancer at study entry were analyzed. The 2018 WCRF/AICR score included seven components: body weight, physical activity, plant-based foods, fast foods, red and processed meat, sugar-sweetened beverages, and alcohol; the optional breastfeeding component was excluded. The final score ranged between 0 and 7 points, with higher values reflecting greater alignment with the WCRF/AICR recommendations. Multivariable Cox proportional hazard models adjusted to account for sociodemographic factors and major health conditions were fitted for estimate hazard ratios (HRs) and 95% confidence intervals (CIs) for all-cause mortality. Results: The sample consisted of cancer survivors with an average age (SD) of 62.7 years old (11.7). Over a median follow-up of 11.8 years, a total of 220 deaths were registered. The median WCRF/AICR score was 4.6 ± SD 0.9. In multivariable-adjusted analyses, the risk of mortality was lower for participants who scored >5 points (HR = 0.54; 0.37–0.78; *p* value = 0.0010) compared to those who scored 0–4 points. Each one-point increment in the WCRF/AICR score was associated with a 22% decreased risk of all-cause mortality (HR = 0.78; 0.66–0.90; *p* value = 0.0012). Discussion: Higher compliance with the WCRF/AICR recommendations regarding diet, physical activity, and body weight was associated with lower all-cause mortality risk among cancer survivors. These findings suggest that cancer survivors should be encouraged to increase their adherence to the WCRF/AICR recommendations.

Keywords: WCRF/AICR recommendations; cancer prevention; mortality; cancer survivors

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Nutrition-Related Factors and the Progression of Metabolic Syndrome Characteristics over Time in Older Adults: Analysis of the TUDA Cohort [†]

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Abstract: Metabolic syndrome (MetS) is associated with an increased risk of cardiovascular disease and type 2 diabetes mellitus by an estimated two- and five-fold, respectively. Nutrition intervention could help to prevent the progression of MetS and associated pathologies with age, but the precise dietary components and related factors are not well understood. Therefore, the aim of this study was to evaluate the role of nutrition-related factors in MetS as well as the progression of MetS and its components over a 7-year follow-up period in older adults. This investigation involved the secondary analysis of data from the North–South of Ireland Trinity-Ulster-Department of Agriculture (TUDA) study of community-dwelling older adults (≥ 60 y), which were sampled at baseline (2008–2012; $n = 5186$) and follow-up (2015–2018; $n = 953$). Participants were deemed to have MetS if they met at least three of the following criteria: waist circumference (≥ 102 cm for males, ≥ 88 cm for females); HDL cholesterol (< 1.0 mmol/L for males, < 1.3 mmol/L for females); triglycerides (≥ 1.7 mmol/L); blood pressure (systolic ≥ 130 and/or diastolic ≥ 85 mmHg); and HbA1c (≥ 39 mmol/mol). The prevalence of MetS increased with advancing age (67% at baseline vs. 74% at follow-up). The factors at baseline that were predictive of a higher MetS risk at follow-up included waist circumference (OR 1.04, 95% CI 1.00–1.08; $p = 0.038$) and triglycerides (OR 1.77, 95% CI 1.21–2.59; $p = 0.003$). In a detailed dietary analysis conducted at the follow-up time point, higher protein intake (g/kg body weight) was associated with a lower risk of MetS (OR 0.06, 95% CI 0.02–0.20; $p < 0.001$), abdominal obesity (OR 0.10, 95% CI 0.02–0.51; $p = 0.006$), and hypertension (OR 0.022, 95% CI 0.00–0.80; $p = 0.037$), and a higher MUFA intake (g/day) was associated with a lower risk of MetS (OR 0.88, 95% CI 0.78–1.00; $p = 0.030$). No other dietary factors were significantly associated with MetS. In terms of protein quality, participants with MetS compared to those without consumed fewer high-quality protein foods ($p = 0.009$) and consumed more low-quality protein foods ($p < 0.001$). Dietary intervention along with other strategies focusing on potentially modifiable risk factors may delay the progression of MetS in older adults. Efforts to enhance the quantity and quality of protein intake may be warranted to reduce MetS in certain at-risk groups.

Keywords: metabolic syndrome; older adults; nutrition-related factors; protein quality



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Conflicts of Interest: The authors declare no conflict of interest.

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Effects of Long-Term Sunflower Oil vs. Linseed Oil Diets on Fatty Acids Phospholipids and Desaturases in Hepatocytes [†]

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Abstract: Background and Objectives: The liver plays a central role in the biosynthesis and metabolism of fatty acids. The liver's phospholipids fatty acids composition depends on the dietary intake of lipids and the efficiency of enzymatic activity in the liver. Our study aimed to simultaneously investigate the liver's phospholipids fatty acids composition and desaturase activity in response to long-term linseed or sunflower oil diets. Methods: We used adult female C57/BL6 mice and randomly divided them into a control and two other groups treated with 25% linseed or sunflower oils in isocaloric diet conditions. Before treatment, we analyzed the fatty acid profiles in dietary oils and hepatocytes. After 100 days of oil diet, we analyzed the fatty acids composition in the liver through GC-chromatography. Results: Sunflower oil elevated total monounsaturated fatty acids (MUFA) due to the increase in palmitoleic, oleic, and vaccenic acids. Linseed oil elevated linolenic (ALA), eicosapentaenoic (EPA), and docosapentaenoic (DPA) acids and reduced arachidonic (AA) and docosatetraenoic (DTA) acids, reducing the n-6/n-3 ratio. The estimated activity of desaturase 9 was significantly elevated in the sunflower oil group. The estimated activity of desaturase 5 was the highest, while the estimated activity of desaturase 6 was the lowest in the mice treated with linseed oil. Discussion: We showed that long-term linseed or sunflower oil consumption affects the liver's phospholipids fatty acids composition in different ways. Sunflower oil could have beneficial effects on the liver tissue due to the increase in the total MUFA. Based on this and other studies, we conclude that the metabolism of n-3 PUFAs after linseed oil consumption is not sex-specific in the C57/BL6 mice model.

Keywords: phospholipids; fatty acids; long-term high-fat diet; linseed oil; sunflower oil

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Author Contributions: S.R., T.P., and J.D.M. have written the manuscript. S.R. and J.D.M. have conducted experiments. A.T., A.S. and A.I. have supervised the work. A.N. and T.P. have performed statistical analyses. All authors have been involved in interpreting the results, contributed to drafting the discussion, and approved the final version of the manuscript. All authors have read and agreed to the published version of the manuscript.

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Additionally, we conducted all experiments following the ARRIVE guidelines and the National Research Council's Guide for the Care and Use of Laboratory Animals.

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Iron and Folate Intake in Pregnant and Non-Pregnant Women [†]

Joanna Suliburska * and Rafsan Cholik



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Abstract: Iron and folic acid deficiency are common among women of childbearing age and in pregnant women. Poor iron and folate status in women is

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associated with an increased risk of anemia and disorders in the fetus development during pregnancy. The reason for the deficit of these micronutrients is improper nutrition and their low bioavailability. Incorrect eating habits before pregnancy are often continued during pregnancy. The aim of this study was to determine the intake of iron and folate with diet and supplements in non-pregnant and pregnant women in each trimester. The study was conducted on 50 non-pregnant women (NPW), 50 pregnant women in the first trimester (PW_1), 50 women in the second trimester (PW_2), and 44 women in the third trimester (PW_3), aged 19–42 years. We used a validated questionnaire and a 24 h recall nutrition interview. The results were analyzed using the computer software package Aliant. The BMI index was calculated (pre-pregnancy BMI in PW groups). Statistical analysis of the results was performed using Statistica 13.3. It was found that the average BMI was 23.5 kg/m² and was comparable between groups. The energy intake was significantly lower in the PW_2 group (1118 kcal) and markedly higher in the PW_3 group (1925 kcal). The intake of iron and folate from the diet was below RDA in all groups, and was significantly lower in the PW_1 group (27.4% RDA for iron and 23.7% RDA for folate) and markedly higher in the NPW group (55.5% RDA for iron and 66.3% RDA for folate). Only the use of supplementation resulted in an adequate intake of iron and folates, wherein the iron supplements were used by 14% of NPW, 46% of PW_1, 40% of PW_2, and 5% of PW_3, and folate supplements were as follows: 36%, 68%, 58%, and 23%, respectively, in the analyzed groups. In conclusion, the supply of iron and folates from the diet in non-pregnant and pregnant women is low (below 50% RDA in PW in each trimester and between 50 and 60% RDA in NPW). With such a low supply of these micronutrients, supplementation seems necessary for women.

Keywords: iron; folate; pregnancy; women

Author Contributions: Conceptualization, J.S.; methodology, J.S.; software, J.S.; validation, J.S. formal analysis, J.S.; investigation, J.S.; resources, J.S.; data curation, J.S. and R.C.; writing—original draft preparation, J.S. and R.C.; writing—review and editing, J.S.; visualization, J.S.; supervision, J.S.; project administration, J.S.; funding acquisition, J.S. All authors have read and agreed to the published version of the manuscript.

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The Effect of Gingko Biloba Extract and Zinc Supplementation on Iron Status in Diabetic Rats [†]

Ewelina Król * , Halina Staniek , Joanna Mikołajczyk-Stecyna  and Zbigniew Krejpcio 



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Diabetes is a metabolic disease characterized by changes in carbohydrate and lipid metabolism. In turn, prolonged hyperglycemia may lead to increased oxidative stress and changes in the status of elements, including iron. Both ginkgo biloba extract (GBE) and zinc (Zn) may play a role in glycemic control. In this study, the effect of these ingredients both individually and in combination on the parameters of iron metabolism in diabetic rats was assessed. The experiment was carried out on male Wistar rats. The control group fed a standard diet (AIN-93M) was created, and in the rest of the rats diabetes was induced by feeding a high-fat diet and streptozotocin injection. Then, diabetic rats were divided into four groups: diabetic control, diabetic supplemented with Zn, diabetic supplemented with GBE, and diabetic supplemented with Zn and GBE. The doses of these supplements were 150 mg/kg diet for Zn and 0.8% for GBE, respectively. Rats were fed the diets for 6 weeks. During the autopsy, internal organs (liver, kidneys, spleen, pancreas, testis and heart) were collected. The content of Fe in tissues was determined by the AAS method followed by microwave digestion. Moreover, the serum ferritin concentration was measured. The significance of differences between the groups was analyzed by one-way analysis of variance and Tuckey's post-hoc test. The induction of diabetes resulted in a significant increase in Fe content in the pancreas and liver, as well as serum ferritin levels. Zn supplementation had no effect on the parameters studied. However, it was found that GBE alone and in combination with Zn significantly normalized the parameters studied in diabetic rats. In conclusion, GBE supplementation significantly improved the parameters of Fe metabolism, probably due to the fact that the extract contains compounds showing the ability to chelate iron ions.

Keywords: ginkgo biloba; zinc; diabetes; iron

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Dietary Polyphenol Intake in Relation to Ultra-Processed Food Consumption in a Mediterranean Population-Based Cohort: Findings from the Moli-Sani Study [†]

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Abstract: Background and objectives: Ultra-processed foods (UPFs) have been consistently associated with the increased risk of premature mortality and diseases in numerous cohorts worldwide, possibly due to their poor nutritional composition. However, UPFs could also be deficient in several bioactive compounds, such as polyphenols, which are otherwise largely present in a variety of fresh foods, such as fruit, vegetables, and cereals. We therefore examined the dietary polyphenol content in relation to the degree of processing according to the Nova classification. Methods: The data were from the Moli-sani Study established in 2005–2010, including 22,939 men and women (mean age 55.4 y ± 11.7). Dietary data were collected using a 188-item food frequency questionnaire, and the polyphenol intake was calculated by matching the food consumption data with the Phenol-Explorer database regarding the polyphenol content of each reported food. NOVA classification was used to categorize the foods according to the levels of processing as unprocessed/minimally processed foods (e.g., fruits; meat) or UPFs (e.g., processed meat; packaged snacks). Results: The average (SD) weight contributions of the unprocessed/minimally processed foods and UPFs to the diet were 63.1% (±11.8) and 11.0% (±6.7), respectively. The mean intake of polyphenols was 665 (±265) mg/day. In multivariable-adjusted linear regression analysis controlled for the sociodemographic, behavioral and clinical factors, more UPF intake was associated with fewer dietary polyphenols ($\beta = -59.2$; 95% CI: from -62.1 to -56.3 mg/day of polyphenols for 1-SD increase in UPF). On the contrary, unprocessed/minimally processed food consumption was linked to more polyphenols in the diet ($\beta = 25.5$; 95% CI: 22.2 to 28.7). Discussion: In this large cohort of Italian adults, an increasing dietary share of UPFs would provide lower amounts of polyphenols in the diet, while consuming fresh and minimally processed foods is associated with a higher intake of polyphenols. Future studies are needed to test whether a low dietary polyphenol content has an effect on UPF–disease relationship.

Keywords: polyphenols; food processing; Nova classification

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Salicylate Intake in Pregnant and Non-Pregnant Women [†]

Joanna Suliburska *  and Rafsan Cholik



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Abstract: Salicylates are naturally present in plants. In medicine, acetylsalicylic acid (aspirin) is widely used as an analgesic, antipyretic, and anti-inflammatory agent and also as a preventive medicine for preeclampsia in pregnancy. The main sources of salicylates are vegetables, herbs, and spices. It

is observed that salicylates present in a diet rich in vegetables and herbs are largely responsible for the positive effects of these foods on human health. Therefore, the aim of this study was to determine the total salicylate intake in pregnant and non-pregnant women. This study was conducted on 105 non-pregnant women (NPW) and 98 pregnant women (PW) aged 19–42 years old. PW were at 11–12 weeks of gestation. We used a validated questionnaire and a 24 h recall nutrition interview. The results were analyzed using the original database on salicylate content in food and the computer software package Aliant. The BMI index was calculated. A statistical analysis of the results was performed using Statistica 13.3. It was found that in PW, the total intake of salicylates was significantly lower than in NPW as follows: 421.11 ± 51.19 µg/day and 539.32 ± 43.20 µg/day, respectively. PW did not use supplements with salicylates nor aspirin, while 4.4% of NPW used supplements with salicylates, and 15% occasionally used aspirin. The main food sources of salicylates in women were as follows: spices, vegetables and fruits, and cereal products. However, PW used a significantly lower number of spices (especially hot spices) than NPW. In the NPW group, a good source of salicylates was alcohol (beer and wine), while PW did not drink alcohol at all. The energy intake in both groups was not markedly different and was 1612.81 ± 314.07 kcal/day in PW and 1552.40 ± 321.18 kcal/day in NPW. The average BMI of 22.8 kg/m² was comparable between groups. In conclusion, the intake of natural salicylates decreased in pregnancy, which may be associated with the lower beneficial effect of these bioactive substances on health in pregnant women, e.g., increasing the risk of preeclampsia.

Keywords: salicylates; aspirin; pregnancy; preeclampsia

Author Contributions: Conceptualization, J.S.; methodology, J.S.; software, J.S.; validation, J.S. formal analysis, J.S.; investigation, J.S.; resources, J.S.; data curation, J.S. and R.C.; writing—original draft preparation, J.S. and R.C.; writing—review and editing, J.S.; visualization, J.S.; supervision, J.S.; project administration, J.S.; funding acquisition, J.S. All authors have read and agreed to the published version of the manuscript.

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Systematic Review and Meta-Analysis of Chicory Inulin-Type Fructans Supplementation on Weight Management Aspects [†]

Yoghatama Cindya Zanzer * and Stephan Theis 



Citation: Zanzer, Y.C.; Theis, S. Systematic Review and Meta-Analysis of Chicory Inulin-Type Fructans Supplementation on Weight Management Aspects. *Proceedings* 2023, 91, 155. <https://doi.org/10.3390/proceedings2023091155>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Maintaining and reducing weight are considered as important features in reducing mortality and morbidity caused by metabolic-associated diseases. Increasing

evidence from in vivo mechanistic and clinical studies has shown that the gut microbiota is interacting with the host's physiological function in regulating energy intake and body weight. A prebiotic is a substrate that is selectively utilized by host microorganisms conferring a health benefit. Numerous clinical studies showed multifaceted benefits of prebiotic chicory inulin-type fructans (ITFs) on gut and metabolic health. The present systematic review and meta-analysis aimed to synthesize the totality of evidence through pooled estimates of ITF supplementation in supporting weight management on both healthy and diseased subjects. A systematic search for eligible articles was performed in databases (EMBASE, MEDLINE (PubMed), Web of Science) without a language restriction. Two reviewers independently extracted data from eligible articles. We chose primary (body weight) and secondary (BMI, total fat mass, body fat percentage and waist circumference) outcomes as weight management parameters. The baseline-corrected mean difference (MD) was used to synthesize the pooled effect size by employing a random-effects model using the inverse variance method. A sub-group analysis based on dose, duration, health status and ITF-type was also conducted. A total of 31 randomized controlled trials with 40 arms ($n = 1309$ participants) were included in this review. A significant reduction was observed on body weight (MD: -1.03 kg, 95% CI: -1.42 to -0.64 , $p < 0.0001$), BMI (MD: -0.39 kg/m², 95% CI: -0.58 to -0.21 , $p = 0.0001$), fat mass (MD: -0.45 kg, 95% CI: -0.71 to -0.2 , $p = 0.0023$), and waist circumference (MD: -0.99 cm, 95% CI: -1.61 to -0.37 , $p = 0.003$) following ITF supplementation. For body fat percentage, a significant effect was observed following subgroup analysis on an intervention that lasted for more than 8 weeks (MD: -0.78 percent, 95% CI: -1.17 to -0.39 , $p < 0.01$). The present meta-analysis of randomized controlled trials provides further evidence to support that ITF supplementation could help benefit weight management by reducing body weight, BMI, fat mass, waist circumference, and to a certain extent on body fat percentage.

Keywords: inulin-type fructans; weight management; meta-analysis; systematic review

Author Contributions: Conceptualization, Y.C.Z. and S.T.; methodology, Y.C.Z.; software, Y.C.Z.; validation, Y.C.Z. and S.T.; formal analysis, Y.C.Z.; investigation, Y.C.Z. and S.T.; resources, S.T.; data curation, Y.C.Z. and S.T.; writing—original draft preparation, Y.C.Z.; writing—review and editing, Y.C.Z. and S.T.; visualization, Y.C.Z.; supervision, S.T.; project administration, Y.C.Z. and S.T.; funding acquisition, S.T. All authors have read and agreed to the published version of the manuscript.

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Novel Drug and Nutraceutical Delivery System for the Treatment of Inflammatory Bowel Disease [†]

Aoife Murtagh * , Clement Higginbotham and Patricia Heavey 



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Abstract: Background and objectives: Inflammatory bowel disease is a chronic condition

with no cure. However, there are a range of treatment options. Pharmacological approaches are usually the first step in treatment, and they are effective for many patients; however, for some, side effects are evident, and effectiveness can reduce overtime. Research on advanced delivery systems, new drugs and the therapeutic benefits of nutraceuticals such as curcumin have been previously investigated with promising results for IBD treatment, although they present their own unique challenges including poor bioavailability. The poor bioavailability of hydrophobic agents including curcumin is partly attributed to poor solubility and inadequate concentrations at target tissues. Therefore, the aim of the present work was to develop a novel pH-sensitive drug and nutraceutical delivery system featuring microspheres embedded in a hydrogel. **Methods:** Polylactic acid–polyethylene glycol microspheres loaded with dexamethasone (0.8 wt%) and curcumin (0.8 wt%) were synthesised using an emulsion solvent evaporation method. pH-sensitive polyethylene glycol dimethacrylate-co-acrylic acid hydrogels (46.6% and 33.3%, respectively) were synthesised with water (20%) by UV-photopolymerisation. The dexamethasone and curcumin microspheres were embedded into the hydrogels. Hydrogels and microspheres were characterised separately to understand their properties. **Results:** The encapsulation efficiency of the dexamethasone and curcumin microspheres was promising with higher encapsulation efficiency achieved for the curcumin microspheres (29% and 92%, respectively). Swelling studies demonstrated the equilibrium water content (EWC), the ability of the hydrogel to uptake its surrounding solution, with differences observed in response to changes in pH. In pH 6.8, hydrogels took up more of the surrounding solution compared to pH 2.2 (EWC% after 24 h = 69% and 56%, respectively). Gel fraction studies showed that the efficiency of the network formed during photopolymerisation (96%). **Discussion:** This targeted drug and nutraceutical delivery system may have the potential to play a role for IBD treatment with the combined impact of the microspheres in the hydrogel to be established. Dexamethasone and curcumin were encapsulated into microspheres which aid their solubility. The hydrogel component may help achieve a targeted delivery system, owing to the changes observed in response to different pH levels, as would be observed along the gastrointestinal tract.

Keywords: inflammatory bowel disease; delivery system; pharmacology; nutraceuticals; microspheres; hydrogels; treatment; management

Author Contributions: Conceptualization, A.M., C.H. and P.H.; methodology, A.M.; formal analysis, A.M.; data curation, A.M.; writing—original draft preparation, A.M.; writing—review and editing, A.M., C.H. and P.H.; supervision, C.H. and P.H.; funding acquisition, C.H. and P.H. All authors have read and agreed to the published version of the manuscript.

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The Effect of Adzuki Bean Extract on Antioxidant and Inflammatory Indices in Diabetic Rats [†]

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Małgorzata Gumienna ³  and Barbara Górna ³ 



Citation: Król, E.; Staniek, H.; Krejpcio, Z.; Szczepankiewicz, D.; Gumienna, M.; Górna, B. The Effect of Adzuki Bean Extract on Antioxidant and Inflammatory Indices in Diabetic Rats.

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Abstract: One of the strategies used to alleviate metabolic disorders in diabetes is nutritional intervention. In order to achieve this goal, plant materials that contain compounds with high antioxidant potential, exhibit digestive enzyme inhibiting activity, or contain substances that improve insulin sensitivity are selected. The importance of legumes in the regulation of carbohydrate metabolism is currently the subject of many studies. Due to high α -glucosidase activity and phenolic profile, Adzuki bean (AB) may be considered as a plant with hypoglycemic and antioxidant properties. Thus, the aim of the study was to assess the effect of AB extract on antioxidant and inflammatory indices in diabetic rats. The experiment was conducted on male Wistar rats. The rats were divided into four groups; one was fed with the AIN-93M diet, while the other three were induced with diabetes by feeding them a high-fat diet for 4 weeks followed by intraperitoneal injection of streptozotocin (35 mg/kg b.w. in citrate buffer). The rats of the control group received citrate buffer alone. After confirmation of hyperglycemia, the rats were divided into three groups: diabetic control, diabetic fed diets supplemented with AB ethanolic extract with a lower dose (0.5%), and diabetic supplemented with AB extract with a higher dose (1%). The feeding period was 4 weeks. In serum, the glucose, CRP, TAS, SOD, CAT, and TBARS were determined. The inflammatory cytokines (TNF- α , IL-6) were measured in the liver and adipose tissue. In this study, induction of diabetes did not reveal strong inflammation in serum measured by serum CRP concentration ($p > 0.05$). However, in the liver, TNF- α and IL-6 increased, and a higher dose of AB extract normalized these indices. The serum

TAS and activity of antioxidant enzymes (CAT, SOD, and ceruloplasmin) were unchanged in all experimental groups. On the other hand, CAT and SOD activity in the liver of diabetic rats decreased, and higher concentrations of AB extract normalized these values to a level comparable to the control group. In conclusion, the higher AB dose supplementation improved antioxidant potential and decreased inflammation in the liver of diabetic rats.

Keywords: Adzuki bean; diabetes; antioxidant; inflammation

Author Contributions: Conceptualization, E.K. and Z.K.; methodology E.K., H.S., D.S., M.G. and B.G.; validation, E.K.; formal analysis, E.K.; investigation, E.K., H.S., D.S. and B.G.; data curation, E.K.; writing—original draft preparation, E.K.; funding acquisition, E.K. and Z.K. All authors have read and agreed to the published version of the manuscript.

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Modulation of Gut Microbiota through Nutritional Interventions in Behçet's Syndrome Patients: Preliminary Results from the MAMBA Study [†]

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Abstract: Background. Recent evidence suggests that the gut microbiota (GM) in Behçet's syndrome patients (BS) has low diversity and a peculiar layout. Diet is known to influence the GM, but to date no study has investigated its effect on these patients. Aim. To evaluate the effect of a lacto-ovo vegetarian diet (VD) and a Mediterranean diet supplemented with 2 g/die of oral butyrate (MD-Bt) in comparison with a Mediterranean diet (MD) on the GM in BS. Methods. Forty-four (27F; mean age: 46.9 ± 11.2 years) BS patients were randomly assigned to follow a VD, MD-Bt, or MD for 3 months each and then crossed over. Stool samples were collected from the participants at the beginning and at the end of each intervention phase. Samples were analyzed through 16S rRNA amplicon sequencing on an Illumina MiSeq platform. Results. Regarding alpha diversity, a decreasing trend after a VD (Shannon index: $p = 0.069$; observed species: $p = 0.08$) and an increasing trend after a MD (Shannon index: $p = 0.084$; observed species: $p = 0.079$) were observed. Regarding beta diversity, no significant separation was found between the sample groups either over time or between different interventions. Phylum-level taxonomic analysis showed a significant increase in Bacteroidetes (+2.6%; $p = 0.049$) following the MD and a significant reduction in Proteobacteria (−0.2%; $p = 0.035$) following the MD-Bt. At the family level, we observed a significant increase in Bacteroidaceae (+2%; $p = 0.05$) and Porphyromonadaceae (+0.3%; $p = 0.004$) after the MD, a significant reduction in Porphyromonadaceae (−0.4%; $p = 0.05$) and Rikenellaceae (−0.7%; $p = 0.03$) after the VD, and a significant reduction in Rikenellaceae (−0.2%; $p = 0.008$) and Turicibacteraceae (−0.02%; $p = 0.04$) after the MD-Bt. In addition, there was a significant increase in the genus Bacteroides (+2%; $p = 0.05$) and Parabacteroides (−0.2%; $p = 0.004$) after the MD. On the other hand, the MD-Bt, led to a significant increase in Clostridium (+1%; $p = 0.05$) and a significant reduction in Oscillospira (−0.6%; $p = 0.011$) and Turicibacter (−1.9%; $p = 0.04$). Conclusions. The MD appeared to have an overall better impact on the GM modulation of BS in terms of higher diversity and potentially beneficial compositional changes.

Keywords: Behçet syndrome; gut microbiota; diet

Author Contributions: Conceptualization, G.P., G.E. and F.S.; methodology, G.P., S.T., G.E. and F.S.; formal analysis, G.P., F.D. and S.T.; investigation, G.P., I.M., M.T.A., G.E. and F.S.; writing—original draft preparation, G.P.; writing—review and editing, S.T., G.E. and F.S.; supervision, F.S. All authors have read and agreed to the published version of the manuscript.

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Association of Omega-3 Index and Blood Cell Count-Derived Systemic Inflammatory Indexes among Testicular Germ Cell Tumor Survivors [†]

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Inflammatory Indexes among Testicular Germ Cell Tumor Survivors.

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Abstract: Background and objectives: Although testicular cancer is considered the paradigm of highly curable malignancy, treatment-induced adverse effects and potential impairment of gonadal function may cause non-negligible long-term health repercussions, including metabolic disturbances and cardiovascular sequelae. This observational, cross-sectional study recruited a sample of testicular germ cell tumor survivors (TGCTs) attending routine follow-up care, with the aim to investigate the relationship between the Omega-3 Index, a promising cardiometabolic risk-assessment biomarker, and complete blood cell (CBC) count-derived systemic inflammation indexes. Methods: Erythrocyte membrane fatty acid (FA) profiling was performed by gas chromatography with flame ionization detection. The Omega-3 index (OI3) was computed by summarizing eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) expressed as a percentage of total FAs. Inflammatory indexes, including NLR (neutrophil-to-lymphocyte ratio), SII (systemic immune-inflammation index (platelet count × NLR)), SIRI (systemic inflammatory response index (monocyte count × NLR)), and AISI (aggregate index of systemic inflammation (monocyte count × SII)) were determined using routinely obtained hematological parameters. Results: In the analyzed cohort ($n = 92$, age $\bar{x} = 35.89 \pm 8.67$ years), the mean value of OI3 was $4.41 \pm 0.92\%$, where 53.26% of men were allocated the high-risk group ($OI3 < 4\%$) and the rest were in the moderate cardiovascular hazard category ($4\% \leq OI3 < 8\%$). The OI3 correlated inversely with the NLR, SII, and AISI ($r = -0.234, -0.241, \text{ and } -0.249$, respectively, all $p < 0.01$). A negative association was determined between the total content of polyunsaturated fatty acids and SIRI ($r = -0.221, p < 0.05$). The NLR and AISI were statistically significantly lower in the subgroup of patients with $OI3 \geq 4\%$ ($p < 0.05$). Discussion: Blood cell count-based inflammatory indexes may contribute to a more efficient risk stratification of TGCTs in relation to cardiometabolic disorders. Further large-scale research and long-term intervention trials are warranted to investigate the clinical significance of an increased intake of anti-inflammatory long-chain omega-3 polyunsaturated FA via dietary sources and/or supplementation in modulating the inflammatory process and reducing the morbidity burden in this patient population.

Keywords: testicular germ cell tumor; Omega-3 Index; systemic inflammatory indexes

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Study of Cardio-Metabolic Risk in Overweight and Obese People with Impaired Vitamin D Status [†]

Maria Nikolova *  and Adriana Agovska



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Abstract: Background: Vitamin D deficiency increases cardio-metabolic risk through different mechanisms: activation of proinflammatory cytokines and

mediation of endothelial dysfunction, insulin resistance, accelerated atherosclerosis, etc. Objectives: To study and analyze the cardiovascular (cardiometabolic) risk in people with different levels of vitamin D. Methods: Laboratory and questionnaire data from 264 adults, mean age 41.19 years, were analyzed. The studied indicators were compared between people with deficiency and normal vitamin D levels, as well as between persons with normal and excessive BMI. Variation and correlation (Spearman's coefficient) were used. Results: It was established that vitamin D deficiency is related to some risk factors and cases of CVD. CVDs are significantly more common in people with vitamin D deficiency (15.9%) compared to 7.1% for those with a sufficiency of vitamin D and high blood pressure (36.4% compared to 27.4%). Overweight and obesity were found in 70.5% and 48.6% of those surveyed, respectively. Diabetes is present in 11.8% of people with vitamin D deficiency, compared to 4.3% in people with vitamin D sufficiency. Survey data show that people with vitamin D deficiency have more often followed a diet in the last year (74.1% compared to 55.7%), most often low-calorie (17.0%), followed by protein (Dukan) (8.0%), low-carbohydrate (4.5%), and starvation (4.5%). Diet is a modifiable risk factor in the prevention of CVD, but the "weight cycle" effect increases the risk of developing and maintaining cardio-metabolic risk and diseases. In persons with an excessive BMI, there has been a significantly more frequent change in weight in the last year: 59.4% compared to 30.6% in the control group ($p < 0.001$). Weight gain was 5.53 kg versus 2.43 kg and was associated with an increased risk of CVD regardless of BMI. Discussion: The study shows that there is an increased cardiovascular risk in people with vitamin D deficiency, which increases if combined with an excessive BMI. Diet and weight variation are important triggers for the occurrence and development of CVD in various BMI and metabolic disorders.

Keywords: vitamin D; cardio-metabolic risk; obesity

Author Contributions: Conceptualization, M.N. and A.A.; software, A.A.; validation, M.N. and A.A.; formal analysis, M.N.; investigation, M.N.; resources, A.A.; data curation, M.N.; writing—original draft preparation, A.A.; writing—review and editing, M.N.; visualization, M.N.; supervision, M.N.; project administration, M.N.; funding acquisition, M.N. All authors have read and agreed to the published version of the manuscript.

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High-Protein Diets Have the Potential to Reduce Gut Barrier Function in a Sex-Dependent Manner [†]

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Abstract: Increased intestinal permeability is linked to low-grade systemic inflammation associated with chronic diseases. Undigested dietary proteins reach the colon, where they are fermented by components of the gut microbiota to produce metabolites shown to increase intestinal permeability in vitro. As evidence for sex differences in the microbiota grows, we hypothesised that the effects of the microbial fermentation of protein would also be sex-dependent. Thus, our objective was to determine whether there were sexual dimorphisms in microbial composition and metabolic output following the fermentation of different proteins using in vitro human gut model systems. Faeces from healthy male ($n = 5$) and female ($n = 5$) donors were used to inoculate gut fermentation systems supplemented with non-hydrolysed proteins (0.9 g) derived from whey, fish, milk, soya, mycoprotein, egg or pea. At 0, 8, 24 and 48 h, the microbiota composition was quantified using fluorescence in situ hybridisation coupled with flow cytometry, while bacterial-derived metabolite production was assessed via gas chromatography/mass spectroscopy and an ELISA. Increased protein availability resulted in significant increases in proteolytic *Bacteroides* spp. ($p < 0.01$) and *Clostridium* coccoides ($p < 0.01$) and significant increases in the production of potentially detrimental metabolites including phenol ($p < 0.01$), *p*-cresol ($p < 0.01$), indole ($p = 0.018$) and ammonia ($p < 0.01$), all of which were highly dependent on protein type. Furthermore, we showed higher abundances of *Clostridium* cluster IX ($p = 0.03$) and concentrations of *p*-cresol ($p = 0.025$) at 24 h in males, while females produced more ammonia ($p = 0.02$) irrespective of the protein source. The fermentation of mycoprotein resulted in significantly higher abundances of *Clostridium* cluster IX in males at 8 and 24 h compared to females ($p < 0.01$). There were also significant interactions between sex, protein source, bacterial populations and bacterial-derived metabolic-end-product concentrations. Our study provides new evidence that the effects of the microbial fermentation of dietary proteins in vitro are highly dependent on the source of the protein and the sex of the donor. Consequently, we suggest that different proteins are likely to have differential impacts on intestinal barrier function in vivo, and these effects may be different in males and females. If corroborated in human studies, our results would have important implications for dietary recommendations to limit chronic diseases.

Keywords: dietary protein; gut microbiota; sexual dimorphisms



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metabolite analyses. J.S.E. conducted the phenolic compound analysis using SPME-GCMS and wrote the methods section for this specific measurement. D.J. and M.C.L. wrote the main manuscript text and prepared all figures. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was given by all individuals who provided samples.

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The Big Poo Review: A ZOE Health Study Deep Dive into the UK's Bowel Habits [†]

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Abstract: Background: Bowel habits remain under-studied despite their associations with chronic diseases and their impact on quality of life. We aimed to elucidate the pattern of bowel habits in the UK and investigate gender differences and dietary associations. Methods: A UK populationbased survey, “The Big Poo Review,” involving 142,765 participants, was conducted in the ZOE Health Study (LRS/DP-20/21-25809). Respondents completed a 37-item bowel habit questionnaire.

Diarrhoea was defined as evacuation >3 times/day or passing Bristol Stool scale (BSS) type 6 or 7 > 25% and constipation was defined as evacuation <3 times/wk or passing BSS type 1 or 2 > 25%. Participants (n = 26,703) who completed a food frequency questionnaire within 5 months of the study were included in the subgroup dietary analysis. Results: Participants were predominantly female (77%) with a mean age of 57.8 years (IQR: 50–67). The most frequently reported bowel pattern was a single daily bowel movement (54%) after breakfast (60%) and BSS type 4 (40%). The mean defecation frequency was 1.7 times/day (SD 0.9), but 0.4% of participants defecated <1 time/wk and 1.4% defecated >4 times/day. Constipation was reported in 21.0% (women 23.3%, men 13.0%; $p < 0.001$) and diarrhoea in 15.3% (men 17.5%, women 14.7%; $p < 0.001$). Those with diarrhoea or constipation consumed significantly fewer legumes, nuts, and seeds (12 g and 7 g/day less, respectively), fruits (14 g and 18 g/day less, respectively), and vegetables (14 g and 30 g/day less, respectively) than those without ($p < 0.01$ for all comparisons). Dairy intake was different between all three groups (constipation 276 g/day; diarrhoea 256 g/day; regular stools 267 g/day; $p < 0.001$ for all comparisons). Discussion: This survey is the largest study of UK bowel habits to date, highlighting gender and dietary differences in habits. The high prevalence of constipation and diarrhoea underscores the need for focused public health efforts and potential nutrition interventions.

Keywords: bowel habits; diarrhoea; constipation

Author Contributions: Conceptualization, S.B., J.W., T.S. and W.B.; methodology, W.B. and I.L.; formal analysis, A.P.; data curation, A.P. and W.B.; writing—original draft preparation, K.B.; writing—review and editing, S.B., T.S. and W.B.; All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Improvement in Vitamin D Status and Long-Term Incidence of Type 2 Diabetes in the General Finnish Population—Evidence Based on Cohort and Register Datasets [†]

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Abstract: Background and objectives: Large improvements in vitamin D status (serum 25-hydroxyvitamin D; S-25(OH)D) have been recorded among the general Finnish population, mainly due to vitamin D fortification policies and supplement use. Vitamin D intake has increased since the beginning of the fortification scheme in 2003 and subsequently by its increment in 2010. Also, vitamin D supplement use has increased over the years. However, whether sufficient vitamin D status lowers the risk of diabetes is unclear. Hence, we investigated the association between the improved vitamin D status in the Finnish adult population and long-term incidence of type 2 diabetes (T2D). Methods: This study evaluated data of Finnish adults aged ≥ 30 years ($n = 3014$) in a longitudinal setting (Health 2000/2011 cohort) who did not have T2D at baseline. The S-25(OH)D concentrations from both time points (years 2000 and 2011) were standardized according to the Vitamin D Standardization Program. The survey datasets were linked with incident T2D datasets from the national register for the time period 2000–2019. Associations between vitamin D status, change in S-25(OH)D concentrations and incidence of T2D over the 8-year follow-up period were assessed using logistic and Cox regression models (adjusted for age, sex and blood sampling season, etc.). Results: Over the 8-year follow-up period, 214 T2D incident cases were observed in subjects who participated in both Health 2000 and Health 2011. We observed a borderline significantly lower mean baseline S-25(OH)D concentration among T2D cases (45.4 [SD = 12.3] nmol/L) compared with participants not having T2D (48.1 [SD = 134.6] nmol/L) ($p = 0.01$). Having a sufficient vitamin D status (S-25(OH)D ≥ 50 nmol/L) at baseline was associated with lower odds of T2D (adjusted OR 0.94 [95% CI 0.89–0.98]). In participants whose S-25(OH)D concentrations increased over the years, the T2D incidence was lowered (adjusted HR 0.01 [95% CI 0.00–0.01] and 0.82 [95% CI 0.76–0.89] for $\Delta \geq 50$ nmol/L). Discussion: Our preliminary findings indicate a protective effect of increased 25(OH)D (up to 50 nmol/L) against T2D among Finnish adults with an initially low vitamin D status. This study shows that well-designed longitudinal cohorts using standardized methods carry valuable potential to evaluate national nutrition status and to investigate the relationship between nutrition status and chronic diseases.

Keywords: vitamin D status; type 2 diabetes; cohort; register, 25-hydroxyvitamin D

Author Contributions: Conceptualization, F.A.A., S.T.I., M.E. and C.L.-A.; methodology, T.J., T.H. and K.D.C.; validation, T.J., T.H. and C.L.-A.; formal analysis, F.A.A.; data curation, T.J.; writing—original draft preparation, F.A.A.; writing—review and editing, F.A.A., S.T.I., T.H., M.E. and C.L.-A.; supervision,

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T.J., S.T.I., M.E. and C.L.-A.; project administration, C.L.-A.; funding acquisition, F.A.A. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: Both surveys (Health 2000/2011) were conducted in accordance with the Declaration of Helsinki. The protocol for Health 2000 was approved by the Ethical Committee for Research in Epidemiology and Public Health, while Health 2011 was approved by the Coordinating Ethics

Committee at the Hospital District of Helsinki and Uusimaa in Finland. Ethics approval for the usage and linkage of survey datasets to national registers was obtained from the Finnish Institute for Health and Welfare.

Informed Consent Statement: Written informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Restrictions apply to the availability of these data. Data was obtained from the Finnish Institute for Health and Welfare with permission (<https://thl.fi/en/web/thlfi-en/research-and-development/research-and-projects/health-2000-2011>).

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Carbohydrate (CHO) Intake and Quality during Adolescence and Association with HOMA2-IR in Adulthood—The Role of the Chronotype [†]

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- [†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background/objectives: Adolescence is associated with two risk markers of Type 2 Diabetes Mellitus (T2DM): insulin resistance and lateness in chronotype. Hence, negative eating behavior during adolescence may increase the future risk of T2DM. We investigated the prospective relevance of carbohydrates (CHO) from high GI sources consumed in the morning and in the evening during adolescence for HOMA2-IR in young adulthood and the role of chronotypes. Methods: Examinations of subjects were performed at the DONALD study centre. Participants provided at least two 3-day weighed dietary records (median = 7 records) during adolescence and one blood sample in young adulthood. CHO quality was classified as low (<55) and moderate (≥55) according to the Glycemic Index. Chronotype was assessed with the Munich Chronotype Questionnaire and defined as age and sex-adjusted midpoint of sleep on free days corrected for sleep debt on workdays (MSFsc) using all measurements from adolescence up to young adulthood, applying regression analyses. Earlier and later chronotypes were based on the averaged median values of MSFsc. We used the HOMA2 calculator (University of Oxford) to define HOMA2-IR from fasting insulin and glucose measures. Multivariable regression analyses (including, e.g., age, sex, BMI-SDS, physical activity and energy) assessed the longitudinal associations of interest. Testing for trend calculations were based on median values per tertile. We assessed interactions by chronotype and additionally stratified the data according to chronotype. Results: A total of N = 224 (♀n = 58%) participants with a median (Q1:Q3) age of 12 (12:13) yrs during adolescence and 22 (18:26) yrs at blood withdrawal were included. Stratified analyses by chronotype were not different and there was no significant interaction ($p > 0.05$). Only the residual of adolescent CHO consumption in the morning (<11:00



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hh:mm) was significantly, inversely associated with adult HOMA2-IR (Ismeans HOMA2-IR T1: 2.96 (2.41–3.55) vs. T3: 1.95 (1.54–2.41), *p* for trend = 0.01). Discussion: Our data suggest that the consumption of CHO in the morning decreases HOMA2-IR independent of chronotypeThe results presented in this article are part

of a research project funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation)-AL 1794/1–2.

Keywords: carbohydrates; glycemic index; adolescents; chronotype; type 2 diabetes mellitus

Author Contributions: U.A. and A.B. conceptualized the research; S.A.W. was responsible for immunoradiometric insulin measurements; N.J. analyzed data and performed statistical analysis and

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wrote the abstract; All authors reviewed and edited the abstract and contributed to the interpretation and discussion of the results and approved the final abstract. N.J. had primary responsibility for the final content. Project Administration, N.J.; Funding Acquisition, U.A. and A.B. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data of the DONALD study is available upon reasonable request to epi@uni-bonn.de.

Conflicts of Interest: Anette Buyken is a member of the International Carbohydrate Quality Consortium (ICQC), and a co-author of the popular cookbook “Nordisch abnehmen”.

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Partial Least Square–Cox Regression to Investigate Association between Patterns of Dietary Exposure to Persistent Organic Pollutants and Breast Cancer Risk in the E3N Cohort [†]

Pauline Frenoy ^{1,*} , Francesca Mancini ¹ and Vittorio Perduca ²



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polychlorinated biphenyls (PCBs), per- and polyfluoroalkyl substances (PFASs), brominated flame retardants (BFRs) and polycyclic aromatic hydrocarbons (PAHs), was estimated using food consumption data, collected through a validated semi-quantitative food frequency questionnaire, and food contamination data, as measured in the second French Total Diet Study. ER-positive BC cases were identified through self-administered questionnaires, from next-of-kin spontaneous reports, or through information from the national cause-of-death registry. Partial least square–Cox regression (PLS–Cox), a supervised dimension reduction method, was used to identify POPs patterns associated with ER-positive BC occurrence. Cox proportional hazard models were then used to estimate hazard ratios (HRs) and their 95% confidence intervals (CIs) for the associations between the PLS–Cox patterns retained and the risk of ER-positive BC, adjusted on potential confounders identified using a directed acyclic graph. The women were followed for a maximum of 21.4 years, and 5,686 developed incident ER-positive BC. Based on POP intake estimates, five patterns were retained. The first pattern was characterized by positive weights for almost all POPs, especially PAHs and some dioxins. The other principal components were characterized by both positive and negative weights. A significant non-linear and non-monotonic association was highlighted between exposure to the first pattern and ER-positive BC risk, and significant positive linear associations were highlighted between exposure to the second, fourth and fifth patterns and ER-positive BC risk. The use of the PLS–Cox method allowed the identification of relevant patterns in POPs explaining, as far as possible, the covariance between the exposures and the outcomes. Identifying such patterns can help to better clarify the pollutants involved in BC occurrence and to estimate their cumulative effect.

Abstract: Exposure to persistent organic pollutants (POPs) is suspected to play a role in the occurrence of estrogen receptor-positive breast cancer (ER-positive BC). Our objective was to investigate the association between patterns of dietary exposure to POPs and ER-positive BC risk in the E3N cohort. The study included 67,879 women. The intake of 81 POPs, including dioxins,

Keywords: persistent organic pollutants; breast cancer; partial least square regression

Author Contributions: Conceptualization, F.M., V.P. and P.F.; methodology, F.M., V.P. and P.F.; formal analysis, P.F.; writing—original draft preparation, P.F.; writing—review and editing, F.M. and V.P. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was approved by the French National Commission for Data Protection and Privacy (ClinicalTrials.gov identifier: NCT03285230).




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Conflicts of Interest: The authors declare no conflict of interest.

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Ultra-Processed Food Consumption and Biological Aging in Italian Adults from the Moli-Sani Study Cohort [†]

Simona Esposito ¹, Alessandro Gialluisi ², Augusto Di Castelnuovo ³, Simona Costanzo ¹, Emilia Ruggiero ¹ , Licia Iacoviello ^{1,2,*}  and Marialaura Bonaccio ¹ 



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individual. Rather, biological age (BA) or hypothetical underlying “functional” age has been proposed as a relevant indicator of healthy aging. Diets high in polyphenol-rich foods, such as the Mediterranean diet, were inversely associated with biological aging in several cohorts. However, the nutritional content is only one aspect of overall food health potential, and increasing attention should be paid to non-nutrient food characteristics, such as food processing. Ultra-processed foods (UPFs) are mostly industrial formulations designed to maximize palatability and consumption through a combination of calorie-dense ingredients and chemical additives, and have been consistently associated with the increased risk of premature mortality and diseases. We therefore examined the association of UPF with biological aging. **Methods:** A cross-sectional analysis of a sub-cohort of 4510 subjects (aged ≥ 35 years; 52.0% women) enrolled in the Moli-sani Study (2005–2010). Food intake was assessed using a 188-item food frequency questionnaire. UPF was defined according to the Nova classification and calculated as the ratio (%) of UPF (g/d) to total food consumed (g/d), and categorized into sex-specific quintiles. Diet quality was assessed using the Food Standards Agency Nutrient Profiling System (FSAm-NPS) dietary index. A Deep Neural Network approach based on 36 circulating biomarkers was used to compute BA, and the resulting difference ($\Delta\text{age} = \text{BA} - \text{CA}$) was tested as a dependent variable in multivariable linear regression analyses including known risk factors. **Results:** The mean CA (SD) was 55.6 y (± 11.6 years), BA 54.8 y (± 8.6 years), and $\Delta\text{age} -0.77$ (± 7.7). In multivariable-adjusted analyses also including the FSAm-NPS dietary index, a higher intake of UPF consumption was directly associated with accelerated biological aging ($\beta = 0.61$; 95%CI 0.05 to 1.17 for Q5 vs. Q1). **Discussion:** High UPF consumption was directly associated with a blood-markers-based measure of biological aging, independent of overall diet quality. These findings suggest that biological aging could be influenced by non-nutrient food characteristics (e.g., altered food matrix, contact materials and neoformed compounds). Longitudinal studies are warranted to examine whether accelerated biological aging could fall on the pathway between UPF consumption and chronic disease onset.

Keywords: ultra-processed foods; biological age; diet quality

Abstract: Background and objectives: Chronological age (CA) may not accurately reflect the health status of an

Author Contributions: Conceptualization, S.E. and M.B.; methodology, A.G.; formal analysis, S.E., A.D.C. and A.G.; data curation, S.C. and E.R.; writing—original draft preparation, S.E.; writing—review and editing, M.B.; supervision, L.I.; project administration, L.I.; funding acquisition, L.I. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The Moli-sani study was granted the approval of the Ethics Committee of the Catholic University in Rome, Italy, ID Prot. pdc. P.99 (A.931/03-138-04)/C.E./2004. **Informed**

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Data Availability Statement: The data underlying this article will be shared on reasonable request to the corresponding Author. The data are stored in an institutional repository (<https://repository.neuromed.it> (accessed on 29 November 2023)) and their access is restricted by the ethical approvals and the legislation of the European Union.

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An Unhealthy Dietary Pattern-Related Metabolic Signature Is Associated with Cardiometabolic and Mortality Outcomes: A Prospective Analysis of the UK Biobank Cohort [†]

Alvaro Torres-Martos ¹, Augusto Anguita-Ruiz ^{1,2}, Oscar Rangel-Huerta ³ , Concepcion M. Aguilera ¹  and Carmen Piernas ^{1,4,*} 



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Abstract: Background and objectives: An unhealthy dietary pattern (DP) previously identified in the UK Biobank population was positively associated with incident cardiovascular disease (CVD), type 2 diabetes (T2D) and mortality. Differences in individuals' metabolic responses to this DP may help identify novel pathways explaining the observed associations. This study aimed to identify metabolomic signatures characterising adherence to the DP and to investigate prospective associations with cardiometabolic and mortality outcomes. Methods: A cohort of n = 102,862 UK Biobank participants was studied, of which n = 28,123 participants with data on the DP of interest (derived from 2 or more 24 h dietary assessments at baseline) and available metabolomic data (n = 119 metabolites) were used to construct a DP-related metabolic signature score (DPMS) reflecting adherence to the previously identified DP. Metabolomic data were obtained from randomly selected EDTA plasma samples collected at baseline using a high-throughput NMR-based profiling platform. A sparse partial least squares (sPLS) model was used to compute the coefficients needed to calculate the DPMS. Multivariable Cox-proportional hazard models were used to investigate prospective associations between the DPMS and CVD, T2D and mortality outcomes in all participants with available metabolomic data. Results: A DPMS consisting of 46 differential metabolites was calculated, characterised by higher plasma levels of creatinine, saturated fatty acids and sphingomyelins, but lower levels of docosahexaenoic acid, omega 3 and 6 fatty acids and linoleic acids. During an average of 12 years of follow-up, 10,236 cases of total CVD, 5675 cases of T2D and 6367 cases of all-cause mortality were observed in the study sample (mean age 56 years; 55% women). We found significantly positive associations between the DPMS and total CVD events (hazard ratio [HR] per z-score increment = 1.16 [95%CI 1.14–1.18]) and between the T2D (HR per z-score increment = 1.24 [95%CI, 1.22–1.26]) and all-cause mortality (HR per z-score increment = 1.13 [95%CI, 1.10–1.15]). Conclusions: A newly identified metabolic signature reflecting higher adherence to an unhealthy dietary pattern was characterised by metabolites that indicated a poor lipid metabolism. This metabolic signature showed stronger associations with cardiometabolic and mortality outcomes than those observed previously with traditional dietary pattern measurements. Keywords: dietary pattern, plasma metabolomics, cardiometabolic outcomes, mortality, cohort study.

Keywords: dietary pattern; metabolomics; health outcomes; cohort study

Author Contributions: Conceptualization, A.T.-M., A.A.-R., O.R.-H., C.M.A. and C.P.; methodology, A.T.-M., A.A.-R., O.R.-H., C.M.A. and C.P.; formal analysis, A.T.-M., A.A.-R., O.R.-H. and C.P.; writing—original draft preparation, A.T.-M. and C.P.; writing—review and editing, A.T.-M., A.A.-R., O.R.-H., C.M.A. and C.P.; funding acquisition, C.P. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The UK Biobank study was conducted according to the Declaration of Helsinki, and ethical approval was granted by the Northwest Multi-Centre Research Ethics Committee (reference number 06/MRE08/65).

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Data Availability Statement: This research was conducted using the UK Biobank resource under application number 14990. Data can be obtained upon application to the UK Biobank.

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No Difference in the Effects of Consuming Commercially Relevant Palmitic Acid- and Stearic Acid-Rich Interesterified Fats on the Plasma Total Cholesterol to High-Density Lipoprotein Cholesterol Ratio: The INTER-SAT Study [†]

Wendy L. Hall ^{1,*} , Eleanor Wood ¹, Peter J. Joris ² , Johanna H. Bruce ³, Ronald P. Mensink ² and Sarah E. Berry ¹



Citation: Hall, W.L.; Wood, E.; Joris, P.J.; Bruce, J.H.; Mensink, R.P.; Berry, S.E.

No Difference in the Effects of Consuming Commercially Relevant Palmitic Acid- and Stearic Acid-Rich Interesterified Fats on the Plasma Total Cholesterol to High-Density Lipoprotein Cholesterol Ratio: The INTER-SAT Study. *Proceedings* **2023**, *91*, 31. <https://doi.org/10.3390/proceedings2023091031>

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Abstract: Background and Objectives. Randomly interesterified (IE) palmitic acid (16:0)- and stearic acid (18:0)-rich fats are commonly used by the food industry for applications such as spreads and bakery products. Previous studies demonstrate that 18:0-rich fats (unlike 16:0-rich) do not increase the total:HDL cholesterol ratio (TC:HDL), but the comparative effects of commercially relevant IE fats rich in 16:0 or 18:0 are unclear. Hypothesis: An IE 16:0-rich fat will have equivalent effects on the TC:HDL when compared with a functionally matched 18:0-rich fat. Methods. A randomised crossover trial (clinicaltrials.gov NCT04418102; funded by the Malaysian Palm Oil Board) in healthy adults aged 35–65 was conducted. IE fats provided 10% energy intake for 6 weeks per arm with a minimum 4-week washout period. IE fats were formulated into hardstocks that were baked into muffins and blended into spreads. Spreads contained either 54% IE palm stearin/kernel (PSK) hardstock (16:0, 49%; 18:0, 5%) blended with 36% rapeseed oil (final spread: 16:0, 32%; 18:0, 4%), or 54% IE fully hydrogenated rapeseed oil/coconut oil/high oleic sunflower oil/sunflower oil hardstock (16:0, 7%; 18:0, 41%) blended with 36% rapeseed oil (final spread: 16:0, 6%; 18:0, 25%). The study was conducted at King's College London and Maastricht University. Results: A total of 51 eligible volunteers were randomised to the treatment sequence; 47 participants completed the study (24 females/23 males; mean age 52 years, SD 8; mean BMI 25.6, SD 3.0). The TC:HDL did not change following FHS (0.03, 95% CI −0.06, 0.12) or PSK (−0.03, 95% CI −0.11, 0.06) and changes did not differ between groups (0.05, 95% CI −0.08, 0.18). The total, HDL and LDL cholesterol and triglyceride concentrations did not change following PSK or FHS and there were no differences in changes between groups. Discussion: Consuming foods made with commercially relevant IE fat blends rich in 16:0 at 10% of the energy intake is unlikely to have a detrimental effect on the TC:HDL when compared with IE fat blends rich in 18:0. These results provide much-needed evidence of the cardiometabolic health effects of industrially processed fats relevant to oil and fat manufacturers, the food industry, health authorities and healthcare professionals.

Keywords: saturated fatty acids; cholesterol; lipids; randomised controlled trial

Author Contributions: Conceptualization, S.E.B. and R.P.M.; methodology, S.E.B., R.P.M., P.J.J., J.H.B. and W.L.H.; formal analysis, W.L.H.; investigation, E.W. and P.J.J.; data curation, E.W. and P.J.J.; writing—original draft preparation, W.L.H.; writing—review and editing, S.E.B., J.H.B., R.P.M. and P.J.J.; funding acquisition, S.E.B. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data may be shared upon request.

Conflicts of Interest: S.E.B. receives consultancy payments/options from Zoe Ltd. (London, UK). J.H.B. works for ADM Trading (UK) Ltd., a major manufacturer of vegetable fats and oils.

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Associations of Circulating Gamma-Linolenic Acid and Cardiometabolic Health in Chinese Adults: A Prospective Study [†]

Yu-Ming Chen ^{*} , Hai-Li Zhong, Yan Yan, Ying-Di Yang, Hang-Zhu Chen and Ting-Yu Sun



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Abstract: Background: Previous studies have shown that dietary and circulating n-6 polyunsaturated fatty acids (n-6 PUFAs) have beneficial associations with cardiometabolic health in humans. However, some studies showed inconsistent associations between circulating gamma-linolenic acid (GLA, C18:3 n-6), a metabolite of linoleic acid (LA, C18:2 n-6), and cardiometabolic health compared to LA. Therefore, this study aimed to examine the associations of erythrocyte GLA proportions with the presence and incidence of cardiometabolic diseases in Chinese adults. Methods: This prospective study included 3591 participants (40–80 years) from the Guangzhou Nutrition and Health Study, South China. The participants were recruited from 2008 to 2013 and followed up every 3 years. Erythrocyte fatty acids were determined using the baseline samples. Assessments of metabolic syndrome (MetS), carotid intima-media thickness, blood lipids, and questionnaire interviews were conducted at each visit. The associations between erythrocyte GLA and the presence and incidence of MetS, carotid artery plaque (CAP), and coronary heart diseases (CHD) were analyzed using logistic and Cox regression models after adjusting for potential covariates. Results: Among the 3591 participants at baseline, 1155, 941, and 417 had MetS, CAP, and CHD, which were included in the cross-sectional analyses. After a median of a 9-year follow-up, 935/2436, 1172/2203, and 524/2507 participants (case N/total N followed up) developed MetS, CAP, and CHD and were included in the prospective analyses, respectively. Multivariate-adjusted odds ratios (ORs) and 95% confidence intervals (95% CIs) of MetS, CAP, and CHD for the quartile (Q) 4 (vs. 1) of GLA were 3.11 (2.50, 3.87), 1.25 (0.99, 1.58), and 1.54 (1.12, 2.13) (all *p*-trends < 0.05). The corresponding hazard risks (HR) and 95% of the CIs of the 9-year incidences were 1.45 (1.20, 1.75), 1.25 (1.06, 1.48), and 1.40 (1.10, 1.80) (all *p*-trends < 0.05), respectively. However, LA showed beneficial associations with MetS presence (Q4 vs. Q1, OR: 0.65, 95% CI: 0.53, 0.80) and the 9-year CAP incidence (Q4 vs. Q1, HR: 0.78, 95% CI: 0.66, 0.92) (*p*-trends < 0.01). Conclusions: Our findings show a detrimental association between erythrocyte GAL and the presence and incidence of MetS, CAP, and CHD in Chinese adults. Experimental studies are needed to confirm the causal relationship.

Keywords: gamma-linolenic acid; metabolic syndrome; carotid artery plaque; coronary heart diseases; prospective study

Author Contributions: Study conception and design: Y.-M.C.; Obtaining funding: Y.-M.C.; Acquisition of data: H.-L.Z., Y.Y., Y.-D.Y., H.-Z.C., and T.-Y.S.; Data analysis and interpretation: H.-L.Z. and Y.-M.C. Writing of report: Y.-M.C. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: The authors declare no conflict of interest.

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Combination of Adherence to a Traditional Mediterranean Diet and Ultra-Processed Food Consumption in Relation to All-Cause and Cardiovascular Mortality: Prospective Findings from the Moli-Sani Study [†]

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Abstract: Background and objectives: The Mediterranean Diet (MD) has been consistently associated with lower mortality in cohort studies worldwide. Ultra-processed foods (UPF) are increasingly displacing nutritious traditional diets, with alarming health results globally. We examined the combined association of an MD and UPF consumption in relation to all-cause and cardiovascular disease (CVD) mortality in a cohort of Italian adults. Methods: Longitudinal analyses on 22,895 participants of the Moli-sani Study (2005–2010) followed for 12.2 years (median). Food intake was assessed using a 188-item FFQ. UPF was defined following the NOVA classification and calculated as the ratio (weight ratio; %) between UPF (g/d) and total food (g/d). The Mediterranean Diet Score (MDS; range 0–9) was used to assess adherence to MD. Low/High MD adherence (i.e. MDS < 6 or ≥ 6, respectively) was combined with low/high UPF consumption (i.e. < 9.4 or ≥ 9.4% corresponding to the population’s median intake of UPF) to obtain a 4-level dietary variable reflecting dietary combinations from ‘low MD and high UPF’ to ‘high MD and low UPF’. Results: In multivariable-adjusted analysis controlled for known risk factors, compared to the ‘low MD and high UPF’ combination, taken as reference, the ‘high MD and low UPF’ combination had a significant 24% lower rate of all-cause mortality (Hazard ratio = 0.76; 95% CI 0.67–0.86). Participants reporting both “low MD and low UPF” had a significant but only 15% lower death rate (Hazard ratio = 0.85; 0.77–0.95), while individuals consuming both “high MD and high UPF” had a 4% not significant lower death rate (Hazard ratio = 0.96; 0.80–1.14; *p*-value for difference across groups < 0.001; *p*-value for interaction between MD and UPF = 0.47). Similar results were found for CVD mortality, with highest protection observed in the ‘high MD and low UPF’ dietary combination group (Hazard ratio = 0.74; 0.60–0.92) as compared to the reference combination. Discussion and conclusions: The combination of both high adherence to an MD and low UPF intake was associated with lowest all-cause and CVD death rate; the effects of both dietary exposures were additive. Besides the adoption, or maintenance, of an MD, dietary guidelines should also recommend to contextually reduce the dietary share of UPF to maximize Mediterranean diet-related health benefits.

Keywords: Mediterranean Diet; ultra-processed food; survival; cardiovascular mortality

Author Contributions: Conceptualization, M.B. and A.D.C.; methodology, M.B. and A.D.C.; validation, S.C.; formal analysis, M.B.; data curation, S.C. and E.R.; writing—original draft preparation,

M.B.; writing—review and editing, M.B.D., G.d.G. and L.I.; supervision, G.d.G. and L.I. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The Moli-sani study was granted the approval of the Ethics Committee of the Catholic University in Rome, Italy, ID Prot. pdc. P.99 (A.931/03-138-04)/C.E./2004. **Informed**




Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data underlying this abstract will be shared on reasonable request to the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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Adherence to a Mediterranean Diet and Risks of Alzheimer and Parkinson Diseases: A Systematic Review of Population-Based Studies [†]

Sukshma Sharma ^{1,*} , Alessandro Gialluisi ^{1,2}, Maria Benedetta Donati ¹, Giovanni de Gaetano ¹ ,
Vittorio Maglione ³, Licia Iacoviello ^{1,2}  and Marialaura Bonaccio ¹ 



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Abstract: Background and objectives: Diet is suggested as a major modifiable risk factor for neurodegenerative diseases,

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but there is conflicting and inadequate evidence regarding whether adherence to a Mediterranean diet (MD) is associated with lower risks of Alzheimer Disease (AD) and Parkinson Disease (PD). We performed a systematic review of available population-based studies to disentangle the association between MD and risk of AD or PD. Methods: PubMed, MEDLINE, Embase and Scopus were searched for relevant articles published from inception until April 2023. Only observational cohort studies, prospective studies, and case–cohort studies were included to explore the longitudinal association between adherence to an MD and the risk of AD and PD. Studies with adult participants (>18 years old) were included if they explored and reported results on MD, along with other dietary patterns, and examined MD using the following definitions: ‘Medi Score diet’ and ‘alternate Mediterranean diet index (aMED diet)’. Results: A total of three studies (two longitudinal and one case–control) on AD were identified out of 1233 records, and five studies on PD (three longitudinal and two case–control) out of 320 records were identified. For AD, all three studies reported an association between a higher adherence to an MD and a lower risk of AD, with values ranging from 9% (Hazard ratio, 0.91; 95% confidence interval, 0.83–0.98; $p = 0.015$) to 54% (Hazard ratio = 0.46, 95% CI 0.26, 0.79, $p = 0.01$). For PD, three out of five studies reported that a higher adherence to MD was associated with a lower risk of PD, with values ranging from 11% (Hazard ratio = 0.89; 95% CI 0.74–1.07) to 46% (Hazard ratio = 0.54; 95% CI 0.30–0.98). Conclusions/Discussion: The overall longitudinal findings suggested that a high adherence to an MD was inversely associated with the risks of AD and PD, and might be beneficial for nutrition strategies and clinical treatment. However, further epidemiological studies are warranted to increase the generalizability of the findings and to better understand the longitudinal associations for efficient prognosis of AD and PD.

Keywords: Alzheimer Disease; Parkinson Disease; Mediterranean Diet; neurodegenerative diseases

Author Contributions: M.B. and V.M. designed the research; S.S. conducted the systematic literature search, performed the quality assessment and the data extraction; S.S. and M.B. reviewed the study selection; S.S. and M.B. wrote the manuscript; A.G., G.d.G., L.I., M.B.D. and V.M. critically reviewed the manuscript. All authors have read and agreed to the published version of the manuscript.

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Effects of a Dietary Intervention with Lacto-Ovo Vegetarian and Mediterranean Diets on Apolipoproteins, Lipid Profile and Cardiovascular Risk: Results from the CARDIVEG Study [†]

Giuditta Pagliai ^{1,*}, Barbara Colombini ¹ , Marta Tristan Asensi ¹ , Monica Dinu ¹, Sofia Lotti ¹ , Rossella Marcucci ² and Francesco Sofi ¹



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Abstract: Background: Cardiovascular disease (CVD) remains the leading cause of death worldwide. Attention in recent years is turning toward the role that apolipoproteins might play as markers of CVD risk. However, to date, evidence regarding the effects of diet on apolipoproteins is still limited. Aim: To compare the effects of the Mediterranean diet (MD) and lacto-ovo vegetarian diet (VD) on anthropometric parameters, lipid profile, inflammatory profile and apolipoprotein levels, in subjects with low-to-moderate CVD risk. Methods: Fifty-two clinically healthy subjects (39 F; mean age: 49.1 ± 12.4 years), followed an MD and a VD for 3 months each. Demographics, risk factors, dietary and lifestyle habits were collected from each subject at the baseline. Anthropometric parameters and blood samples were obtained both at the beginning and at the end of the MD and VD periods. Results: Both MD and VD resulted in significant reductions in body weight, BMI and fat mass. VD led to a significant reduction in LDL (−5%; $p = 0.038$), while MD led to a significant reduction in plasma triglycerides (−9%; $p = 0.018$). Both diets led to a reduction in most of the inflammatory parameters, but MD was more effective in reducing IL-10 (−37.2%; $p = 0.009$) and IL-17 (−49.1%; $p = 0.002$). As for apolipoproteins, a statistically significant change was observed only for Apo C1 after VD (+24.4%; $p = 0.020$). MD led to a statistically significant negative correlation between Apo C3 and carbohydrates ($R = -0.29$; $p = 0.039$), whereas VD led to a statistically significant negative correlation between Apo D and saturated fats ($R = -0.38$; $p = 0.006$). In addition, a statistically significant positive correlation emerged after MD between change in plasma triglycerides and change in Apo C1 ($R = 0.32$; $p = 0.020$) and Apo D ($R = 0.30$; $p = 0.031$). On the other hand, after VD, a significant positive correlation emerged between change in HDL and Apo D ($R = 0.33$; $p = 0.017$). Subgroup analysis revealed positive effects on apolipoprotein levels from both diets, especially in women, individuals with >50 years and those with <3 CVD risk factors. Conclusions: Both diets resulted in improved apolipoprotein levels, especially in certain population subgroups, while also demonstrating different associations with specific dietary nutrients.

Keywords: cardiovascular risk; apolipoproteins; Mediterranean diet; vegetarian diet

Author Contributions: Conceptualization, G.P., B.C., M.D. and F.S.; methodology, G.P., B.C., M.D. and F.S.; formal analysis, G.P. and B.C.; investigation, G.P., M.T.A., M.D., S.L. and F.S.; writing—original draft preparation, G.P.; writing—review and editing, B.C., R.M. and F.S.; supervision, F.S. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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Circulating NMR Metabolites in White and British Indian Vegetarians and Non-Vegetarians in the UK Biobank [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Metabolomics is influenced by diet and may inform underlying mechanisms for diseases. We aimed to assess differences in circulating metabolites between people of different habitual dietary groups. Methods: The UK Biobank recruited 500,000 adults aged 40 to 69 years throughout the UK between 2006 and 2010. Plasma samples were collected from almost all participants at recruitment, and metabolomics assays (249 metabolites, 168 directly measured and 81 ratios) were performed using nuclear magnetic resonance (NMR) metabolic profiling in a randomly selected subset of 120,000 participants. Participants were asked to report their ethnicity and consumption of red and processed meat, poultry, fish, dairy and eggs. Based on this information, we defined six diet groups among the White British participants (42,963 regular meat eaters, 44,170 low meat eaters, 1051 poultry eaters, 2290 fish eaters, 1521 vegetarians and 102 vegans) and two diet groups among the British Indians (725 meat eaters and 250 vegetarians). We compared adjusted geometric mean levels of the metabolites by diet group. Results: Significant differences in the levels of many plasma metabolites were observed by diet group, with the biggest differences overall for fatty acids. Compared with regular meat eaters, low meat, poultry and fish eaters all had higher omega-3 and docosahexaenoic acid concentrations, while vegetarians and vegans had substantially lower concentrations of these fatty acids and their ratios to total fatty acids. Vegetarians and vegans had significantly higher ratios of omega-6 to both omega-3 and total fatty acids, as well as higher percentages of monounsaturated fatty acids and linoleic acid to total fatty acids. Of the amino acids, vegetarians and vegans had notably higher concentrations of glycine, but lower concentrations of total and individual branched-chain amino acids compared with regular meat eaters. Higher concentrations of citrate but lower concentrations of creatinine in vegetarians and vegans, higher acetate in vegans, as well as differences in many lipid fractions by diet group were also observed. The observed differences were similar for the White British and the British Indian participants. Discussion: The markedly different plasma metabolic profiles between people of different diet groups may impact on their long-term health.

Keywords: vegetarians; vegans; metabolomics

Author Contributions: Conceptualization, T.Y.N.T., T.J.K. and R.C.T.; methodology, T.Y.N.T., J.A.S., T.J.K. and R.C.T.; formal analysis, T.Y.N.T.; investigation, T.Y.N.T.; data curation, T.Y.N.T.; writing— original draft preparation, T.Y.N.T.; writing—review and editing, T.Y.N.T., J.A.S., T.J.K. and R.C.T.; funding acquisition, T.Y.N.T., T.J.K. and R.C.T. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: All participants gave informed consent to participate using a signature capture device at the baseline visit.

Data Availability Statement: This research has been conducted using UK Biobank Resource under application 67506. Bona fide researchers can apply to use the UK Biobank data set by registering and applying at <http://ukbiobank.ac.uk/register-apply/>.

Conflicts of Interest: The authors declare no conflict of interest.

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The Effects of 25-Hydroxyvitamin D3 and Ascorbate on Extracellular Cytokine Concentrations in THP-1 Monocytes and THP-1 Derived Macrophages [†]

Mark Dewane ^{*}, Caroline Childs , Elizabeth Miles and Philip Calder



Citation: Dewane, M.; Childs, C.; Miles, E.; Calder, P. The Effects of 25-Hydroxyvitamin D3 and Ascorbate on Extracellular Cytokine Concentrations in THP-1 Monocytes and THP-1 Derived Macrophages. *Proceedings* **2023**, *91*, 118. <https://doi.org/10.3390/proceedings2023091118>

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Abstract: Vitamins C and D are known to have

immunomodulatory effects. Current recommendations state that plasma 25-hydroxyvitamin D3 should be maintained above 50 nmol/L, although concentrations of 100 nmol/L can enhance health benefits. Concentrations below 25 and 12.5 nmol/L are considered insufficient and deficient, respectively. The typical plasma ascorbate concentration is 50 µmol/L. Vitamin C supplementation can increase plasma concentration to 100–150 µmol/L. Vitamin C insufficiency and deficiency occur at 25 µmol/L and <10 µmol/L, respectively. This study investigates cytokine production by THP-1 monocytes and macrophages, following vitamin C and D treatment at concentrations representing deficiency, insufficiency, sufficiency and following supplementation. Macrophages were differentiated from THP-1 monocytes using PMA. THP-1 cells (monocytes or macrophages) were pre-treated with ascorbate or 25-hydroxyvitamin D3 for 24 h at the aforementioned concentrations, then challenged with lipopolysaccharide for 6 and 24 h. Extracellular concentrations of IL-1β, IL-6, IL-10 and TNF-α were measured using Luminex assays. In THP-1 monocytes, 25-hydroxyvitamin D3 and ascorbate, at concentrations representing sufficiency and supplementation, decreased TNF-α, IL-1β and IL-6 at 6 and 24 h. Ascorbate at concentrations of >50 µmol/L also increased IL-10 at both time points. At supplemented concentrations, 25-hydroxyvitamin D3 and ascorbate lowered the TNF-α/IL-10 ratio from 39:1 to 31:1 and 17:1, respectively, at 6 h. At 24 h, TNF-α/IL-10 was lowered from 88:1 to 31:1, following 150 µmol/L ascorbate treatment, and from 185:1 to 108:1 following 100 nmol/L 25-hydroxyvitamin D3 treatment. In THP-1 macrophages, pro-inflammatory cytokines were unaffected by 25-hydroxyvitamin D3 at 6 h. However, IL-10 concentration increased at concentrations > 50 nmol/L. At 24 h, the inflammatory cytokines decreased as the 25-hydroxyvitamin D3 concentration increased. 25-hydroxyvitamin D3 (100 nmol/L) reduced the TNF-α/IL-10 ratio from 88:1 to 64:1 at 6 h and from 105:1 to 35:1 at 24 h. Ascorbate, at concentrations representing sufficiency and supplementation, decreased the inflammatory cytokines at 6 and 24 h. Ascorbate at 150 µmol/L decreased TNF-α/IL-10 from 116:1 to 35:1 at 6 h and from 102:1 to 21:1 at 24 h. These data demonstrate that both 25-hydroxyvitamin D3 and ascorbate decrease the inflammatory burden in THP-1 monocytes and THP-1 derived macrophages. Future work will investigate vitamin interactions and underlying mechanisms.

Keywords: monocyte; macrophage; inflammation; cytokine; vitamin D; vitamin C; ascorbate

Author Contributions: Conceptualization, M.D. and P.C.; methodology, M.D.; formal analysis, M.D.; investigation, M.D.; writing—original draft preparation, M.D.; writing—review and editing, C.C., E.M. and P.C.; supervision, C.C., E.M. and P.C.; project administration, P.C.; funding acquisition, P.C. All authors have read and agreed to the published version of the manuscript.

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Early Changes in Observed Eating Behaviours and Suboptimal Weight Loss in Gastric Bypass Patients: Preliminary Findings [†]

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Keywords: gastric bypass; suboptimal weight loss; energy intake; eating behaviours



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Bariatric surgery is the most effective long-term treatment for severe obesity [1], however despite excellent results being obtained at the group level, the response and durability of weight loss after surgery is heterogeneous and a proportion of patients may experience suboptimal weight loss (SWL) [2]. The mechanisms underlying SWL are poorly understood but may be linked to eating behaviours [2].

The aim of this work was to identify if early changes in energy intake (EI) and eating behaviours at 1-year are associated with long-term weight outcomes 5-years postsurgery. Twenty-two patients, after gastric bypass (gender: 18 F, 82.0%, $46.2 \pm 1.6\text{kg/m}^2$, 46.1 ± 2.6 years), attended residential research appointments pre-surgery (−1 month) and at 12- and 60-months post-surgery. At each time point, EI (MJ) and eating behaviours (dietary energy density, eating speed, and number, size and duration of eating occasions) were determined over a 24-h period using the covert weighing of food and validated via closed circuit television. Body composition was measured using dual-energy X-ray absorptiometry and the percentage of total weight loss (%TWL) used to distinguish between patients who had suboptimal (<15% TWL) and patients with optimal weight loss (15–25%, or, >25% TWL) at 5 years post-surgery.

Briefly, 5 patients experienced SWL ($-9.2 \pm 1.8\%$), while 7 patients experienced 15–25% TWL ($-21.9 \pm 1.4\%$), and 10 patients experienced >25% TWL ($-35.0 \pm 1.8\%$). There were no differences in EI or dietary energy density between the three groups at baseline, or percentage changes at 1-year post-surgery (ANOVA; $p > 0.54$ and $p > 0.48$, respectively). Those experiencing SWL did not change their eating speed post-surgery, whilst those with optimal weight loss (>25%) reduced their eating speed ($+7.2 \pm 0.53$, $+133.8 \pm 0.53\%$, $-18.9 \pm 21.2\%$, for SWL [$<15\%$], 15–25% and >25% TWL; $p = 0.01$). Those with optimal weight loss also decreased their EI per eating occasion at 1 year ($-53.2 \pm 2.8\%$, $+88.9 \pm 105.0\%$, $-57.8 \pm 6.9\%$, for SWL [$<15\%$], 15–25% and >25% for TWL; $p = 0.01$). These findings indicate that targeting interventions to the stratum of patients

with such eating behaviours could enhance weight loss. Further work is required to verify findings and identify other modifiable eating behaviours in those most at risk of SWL.

Author Contributions: Conceptualization, R.K.P., M.B.E.L., C.L.R. and A.S.; Formal analysis, H.S.; investigation, H.S., A.M., J.S., C.L.R., A.S., M.A.K., C.I.R.G., M.B.E.L. and R.K.P.; writing—original draft preparation, H.S.; writing—review and editing, H.S., A.M., J.S., C.L.R., A.S., M.A.K., C.I.R.G. and R.K.P.; visualization, A.M., J.S., C.L.R., A.S., M.A.K., C.I.R.G., M.B.E.L., R.K.P., Z.B., D.D.K. and D.J.P.; supervision, A.M., J.S., C.L.R., M.A.K., C.I.R.G. and R.K.P.; funding acquisition, R.K.P., C.L.R. and A.S. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Data described in the abstract will be made available upon request pending application and approval.



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The Effects of Low- vs. High-Glycemic Index Mediterranean-Style Eating Patterns on Subjective Well-Being and Sleep in Adults at Risk for Type 2 Diabetes: The MEDGICarb-Intervention Trial [†]

Anna Hjort ^{1,*}, Robert E. Bergia ² , Marilena Vitale ³, Rosalba Giacco ⁴, Gabriele Riccardi ³, Wayne W. Campbell ²  and Rikard Landberg ¹



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Abstract: Background and objectives: Limited evidence exists regarding the influence of glycemic index (GI) in the context of a healthy diet on self-reported health status and sleep. We therefore aimed to investigate the effects of a low- vs. high-GI Mediterranean-style healthy eating pattern (MED-HEP) on subjective well-being and sleep, and whether measures of well-being and sleep were related to glycemia. Methods: The MedGICarb-intervention trial is a 12-week randomized, controlled, parallel multi-center trial (Italy, Sweden and USA). During the intervention, participants consumed an eu-energetic diet profiled as a MED-HEP with either high or low GI. Well-being and sleep were measured by the Medical Outcomes Study 36-Item Short Form Health Survey Version 2 (SF-36v2), Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS) at baseline and after the 12-week intervention. Similarly, postprandial glucose was measured from oral glucose tolerance tests, and indices of glycemic variability were calculated from 24 h continuous glucose monitoring. Results: 161 adults with ≥ 2 features of the metabolic syndrome completed the intervention (53% females, mean age 56 ± 10 y, mean BMI 31 ± 3 kg/m²). Low- vs. high-GI MED-HEP resulted in differential changes between the groups in domains of well-being, driven mostly by improvements in the low-GI group, of which role physical (5.6 AU vs. -2.5 AU, $p = 0.022$) and vitality (6.9 AU vs. -0.3 AU, $p = 0.008$) were significant (ANOVA with group, site and sex as fixed factors and age and BMI as covariates). There was no

significant difference between the diets for aggregated physical or mental components, or for the other domains of well-being (physical functioning, bodily pain, general health, social functioning, role emotional, mental health) or for sleep quality (PSQI) or daytime sleepiness (ESS). The aggregated physical and mental component, as well as some domains of well-being and sleep quality, were correlated with glycemic measures at baseline

(Spearman correlation). Discussion: Low compared to high GI in the context of a MED-HEP resulted in improvements in domains of subjective well-being. No major differences were seen between the groups for indexes of sleep.

Keywords: glycemic index; Mediterranean diet; well-being; sleep; glycemic control

Author Contributions: Conceptualization, R.E.B., R.L., G.R. and W.W.C.; methodology, R.E.B., W.W.C., R.L. and G.R.; investigation, R.E.B., R.G. and M.V.; resources, W.W.C., R.L. and G.R.; data curation, A.H. and A.H.; writing—original draft preparation, A.H.; writing—review and editing, R.E.B., R.G., M.V., W.W.C., G.R. and R.L.; supervision, W.W.C., G.R. and R.L.; project administration, R.E.B., R.G. and M.V.; funding acquisition, G.R., R.L. and W.W.C. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the institutional review board of Federico II University and Purdue University and by the Regional Ethical Review Board, Gothenburg, Sweden. The trial is registered in the public trial database Clinicaltrials.gov as NCT03410719.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: G.R., W.W.C. and R.L. served as co-principal investigators and are thus cosenior authors. G.R. is a member of the Health and Wellbeing Advisory Board of the Barilla company; remuneration for this activity goes to his University Department. R.L. is the project leader for the Nordic Rye Forum, for which funding is provided by industrial partners and NKJ (Nordic Committee of Agricultural Research). R.L. is also principal investigator in research projects funded by Lantmännen and Barilla. He did not receive any remuneration, salary or any other financial recompense from the food industry. W.W.C. reports no competing interests. R.B. is currently employed by ADM. Research presented in this paper was conducted in a former role and has no connection with

ADM. A.H. is offering CGM-based services through her own practice as nutritionist. A.H. has also received consultancy fees from Mäta Health and OneTwo Analytics, two companies that are offering CGM-based services.

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Eating Habits and Sleep Quality in Patients with Type 1 Diabetes on Advanced Technologies [†]

Alessandra Corrado ^{*} , Giuseppe Scidà, Marilena Vitale, Giuseppina Costabile , Giuseppe Della Pepa , Angela Albarosa Rivellese and Lutgarda Bozzetto 



Vitale, M.; Costabile, G.; Della Pepa, G.; Rivellese, A.A.; Bozzetto, L.

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Abstract: Background and
objectives: Sleep disorders are
bidirectionally linked with eating
behaviors and glucose
metabolism, and this could be

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clinically relevant in type 1 diabetes (T1D). We investigated the relationship between dietary habits and sleep quality in T1D. Methods: According to a cross-sectional design, T1D patients, 60 men and 60 women, aged 19–79, using continuous glucose monitoring (CGM) filled-in a 7-day food diary and completed the European Prospective Investigation into Cancer and Nutrition (EPIC) questionnaire on dietary habits and the Pittsburgh Sleep Quality Index (PSQI) questionnaire on sleep quality. Blood glucose values over 6 h after dinner were registered for one week. Differences in dietary habits and blood glucose were compared between the participants with good/bad quality, long/short duration, and long/short onset latency of sleep. Results: Bad sleepers ($n = 84$) were twice as prevalent as good sleepers ($n = 36$) and had significantly higher intake of fat than good sleepers, in particular at dinner time (30.7 ± 10.7 vs. 24.0 ± 10.5 g, $p = 0.004$). Short sleepers had significantly higher usual intake (g/1000 kcal) of coffee and tea (88.7 ± 70.9 vs. 62.0 ± 35.6), alcoholic beverages (46.6 ± 50.4 vs. 28.9 ± 31.5), and carbonated soft beverages (21.0 ± 37.5 vs. 9.3 ± 17.2) ($p < 0.05$ for all). Compared with the short sleep onset latency participants, the long sleep onset latency participants had significantly higher intake of fat at dinner time (41.8 ± 7.4 vs. $38.1 \pm 9.1\%$ total energy, $p = 0.029$). No differences in post-dinner blood glucose were detected between the participants with bad or good sleep quality. Discussion: Sleep disruption is common in T1D and is associated with unhealthy dietary choices, especially at dinner time, independently of post-dinner blood glucose control.

Keywords: sleep quality; dietary habits; type 1 diabetes; sleep latency onset; postprandial glycaemia

Author Contributions: Conceptualization, L.B. and A.C.; validation, M.V., G.C., G.D.P. and L.B.; formal analysis, A.C., M.V., G.C. and G.D.P.; investigation, A.C. and G.C.; data curation, G.S. and A.C.; writing—original draft preparation, L.B., A.C., M.V., G.C. and G.D.P.; writing—review and editing A.A.R. and L.B.; supervision, A.A.R. and L.B.; funding acquisition, L.B. All authors have read and agreed to the published version of the manuscript.

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An Observational Study of the Effect of Diet and Micronutrient Intake on the Association between Depression and Gastrointestinal Symptoms via an Online Survey Tool [†]

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Abstract: Background and objectives: Depression is a low mood-based disorder that affects approximately one in six people in the UK. Analyses of the gut in depressed individuals have demonstrated dysbiosis in the normal gut microbial composition. These imbalances have been associated with gut symptoms such as abdominal pain and nausea. This study aims to investigate the relationships between self-reported depression, gastro-intestinal (GI) symptoms and dietary intake. Methods: Participants with self-reported depression and healthy controls were recruited via Prolific. Participants were asked to complete a web-based online survey tool (Qualtrics), which included questions on diet, gut health and mental health. Estimated micronutrient intakes from reported fruit and vegetable intakes (FAVI) were calculated using dietary analysis software (myFood24). Results: In total, 496 adults consented to participate ($n = 249$ with self-reported lifetime diagnosis of depression, $n = 247$ healthy controls). There was a significant positive correlation between the GI symptom score and the depression score ($r = 0.506$, $p < 0.001$) which included reported measures of nausea ($r = 0.359$) and pain ($r = 0.419$). FAVI and omega-3 intakes were inversely related to GI symptoms ($p = 0.010$, $p < 0.001$, respectively) and depression scores ($p < 0.05$) and significant mediators of the association between GI symptoms and depression (effect size -0.006 , -0.025 respectively). Those with depression were found to have significantly lower intakes of vitamin C, folate, vitamin E and magnesium ($p < 0.05$), though analysis did not identify any significant mediation effects of micronutrient intake on the relationship between GI symptoms and depression scores. Discussion: Dietary intake has a significant mediation effect on the relationship between GI symptoms and depression. Participants in the depression group consumed significantly lower intakes of some important micronutrients found in FAVI, which suggests that depression and gut symptoms could influence food choices. Further research will be required to identify whether these observations correspond to the changes in the microbiome that have been associated with depression.

Keywords: depression; gut; fruit and vegetables; omega-3; probiotic

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Author Contributions: Conceptualization, D.S. and D.G.; methodology, D.S., D.G., C.E.C. and F.S.; formal analysis, F.S. and D.S.; investigation, D.S.; writing—original draft preparation, F.S. and D.S.; writing—review and editing, C.E.C. and D.G.; supervision, C.E.C. and D.G. All authors have read and agreed to the published version of the manuscript.

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The Role of Nutritional Factors in Cognitive Health in Ageing: Shedding New Light through Systematic Review with Meta-Analysis of Intervention Studies [†]

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Abstract: Background: The global population is ageing, with predictions that 150 million people will be living with dementia by 2050. Cognitive dysfunction and dementia have significant adverse impacts on quality of life in older adults. Therefore, the identification of modifiable risk factors is a major public health priority. Evidence suggests that certain dietary patterns and/or specific nutrients can contribute to reducing the risk of dementia; however, the evidence is inconsistent. Objectives: The aim of this systematic review with meta-analysis was to investigate the effect of dietary patterns and specific nutrients on cognitive function in older adults. Methods: The bibliographic databases MEDLINE, EMBASE and PsycINFO were used to identify relevant studies. Inclusion criteria included the following: randomised controlled trials (RCT) with specific nutrients or dietary intervention with control groups; duration ≥ 1 y; and adults ≥ 50 years. Meta-analyses were performed to calculate standardised mean differences (SMD) for global cognition and specific cognitive domains such as memory. Quality of evidence was evaluated using the GRADE (grading of recommendations, assessment, development, and evaluations) assessment framework. A sensitivity analysis was conducted to assess the impact of studies with a high-risk of bias. Results: A total of 23 studies were identified for inclusion in meta-analyses. Results showed that B-vitamin interventions

≥ 1 y had a significant beneficial effect on memory (SMD 0.09, 95% CI, 0.02 to 0.16; 13 studies; 7330 participants; moderate certainty); removing the B-vitamin studies ($n = 3$) at high-risk of bias did not change the overall result. RCTs of vitamin D supplementation improved cognitive function scores (SMD 0.88, 95% CI, 0.08 to 1.67; 4 studies; 4593 participants; very low certainty). No significant cognitive benefits were detected in response to omega-3 supplements; however, the analysis for this outcome was limited by far fewer studies. Discussion: B-vitamins may have specific benefits for the ageing brain. Enhancing the status of these nutrients could contribute to improved cognitive health; however, additional RCTs should target at-risk individuals with sub optimal B-vitamin status.

Keywords: ageing; cognitive function; dementia; dietary patterns; nutrients



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Meat-Based Diet Significantly Affects Risk Parameters for Colorectal Cancer: The MeaTlc Dietary Intervention Study [†]

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Abstract: Background: Colorectal cancer (CRC) is the most commonly diagnosed cancer in Europe and the second most common cause of cancer death. The aim of the MeaTlc study was to determine the impact of three diets associated with different risks of CRC (a meat diet (MBD: high risk), a meat diet with alpha-tocopherol supplementation (MBD-T: medium risk), and a pesco-vegetarian diet (PVD: low risk)) on CRC risk markers and fecal microbiota. Methods: A controlled, randomized, open-label, parallel-group, 12-week dietary intervention was conducted on 113 participants aged 18–50 years. The primary outcome was a change in fecal water (FW) genotoxicity. Secondary outcomes were changes in FW cytotoxicity, bile acids, fecal microbiota, and metabolomic profiles. Results: A total of 103 participants (91%) completed the study. After adjustment for possible confounding factors, a significant increase ($p < 0.05$) in FW genotoxicity (+43%) was observed only in the MBD group. Regarding FW cytotoxicity, a decrease in cell viability (−7%, $p = 0.054$) was observed after MBD, while no changes occurred for the other diets. Bile acid analysis showed an increase in total bile acids during MBD-T (+35%) and a decrease during PVD (−2.3%). Upon correlating changes in bile acids with FW genotoxicity and cytotoxicity, a moderate correlation ($R = 0.66$; $p < 0.0001$) emerged between changes in total bile acids and changes in FW cytotoxicity. A linear discriminant analysis (LDA) of changes in the gut microbiota revealed no clustering by diet, while metabolomic analysis showed a clear clustering of changes in metabolites. A random forest regression model identified 2-hydroxybutyric acid and cholic acids among the metabolites most correlated with FW genotoxicity

($R^2 = 0.84$ for the model). Conclusion: These results indicate that MBD can lead to a worsening of CRC markers in a relatively short time. Our findings also suggest that intervention diets had a greater impact on the metabolism of the gut microbiota, and thus, its metabolites, than on its taxonomic composition. A correlation between some metabolites and FW genotoxicity was also found.

Keywords: meat-based diet; colorectal cancer; microbiota

Author Contributions: Conceptualization, C.D.F., G.C. and F.S.; methodology, M.D. and F.S.; formal analysis, M.D. and S.Ö.; investigation, M.D., G.P., S.L., L.G., S.R. and F.S.; writing—original draft preparation, M.D.; writing—review and editing, C.D.F., L.G., G.C. and F.S.; supervision, C.D.F., L.G., G.C., J.B. and F.S.; funding acquisition, C.D.F., L.G., J.B., G.C. and F.S. All authors have read and agreed to the published version of the manuscript.

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Prognostic Role of Polyunsaturated Fatty Acids in the Adipose Tissue of Colorectal Cancer Patients [†]

Cécile Roux-Levy ^{1,2}, Christine Binquet ^{1,3,4}, Carole Vaysse ⁵ and Vanessa Cottet ^{1,2,3,4,*} on behalf of the AGARIC study group

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Abstract: Background and objectives: Nutritional intake and dysregulation of fatty acid metabolism play a role in the progression of various tumours. The consumption of different fatty acids is difficult to assess accurately by dietary questionnaires. Biomarkers allow objective assessments of intake, storage, and bioavailability. We studied the association between the polyunsaturated fatty acid (PUFA) composition of abdominal subcutaneous adipose tissue (a good indicator of dietary intake over 2–3 years) and all-cause mortality. Methods: In this multicentre AGARIC study, including 203 patients with colorectal cancer (CRC) undergoing curative surgery, samples were harvested from subcutaneous adipose tissue, which were analysed for PUFA composition. Cox proportional hazards models were used to estimate associations between PUFA levels and mortality. Results: After a median follow-up of 45 months, 76 patients died. These patients were more often men (72.4% vs. 57.5%, $p = 0.04$), diabetic (32.9% vs. 13.4%, $p = 0.001$), older (median: 74.5 vs. 66.6 years, $p < 0.001$), and with high alcohol consumption (47.4% vs. 30.7%, $p = 0.005$) compared to survivors. An increased risk of death was observed with higher levels of eicosadienoic acid (hazard ratio tertile3 vs tertile1 (HRT3vsT1) = 2.12; 95% confidence interval (CI) = 1.01–4.42; p -trend = 0.04), adrenic acid (HRT3vsT1 = 3.52; 95% CI = 1.51–8.17; p -trend = 0.005), and 22:5 n-6 (HRT3vsT1 = 3.50; 95% CI = 1.56–7.87; p -trend = 0.002). Conversely, the risk of death seemed to be lower when higher concentrations of γ -linolenic acid (HRT3vsT1 = 0.52; 95% CI = 0.27–0.99; p -trend = 0.04) and the essential fatty acid α -linolenic acid (HRT3vsT1 = 0.47; 95% CI = 0.24–0.93; p -trend = 0.03) were observed. The estimated δ -6-desaturase & elongase 5 enzyme activity were found to be positively associated with all-cause mortality (HRT3vsT1 = 2.25; 95% CI = 1.03–4.90; p -trend = 0.04). Discussion: The risk of death in CRC patients was increased in those with higher concentrations of certain n-6 PUFAs and lower concentrations of α -linolenic acid in their subcutaneous adipose tissue. These results reflect both dietary habits and altered fatty acid metabolism. Nevertheless, our exploratory results need to be confirmed in larger studies with further exploration of the mechanisms involved. The AGARIC study group: Scherrer Marie-Lorraine (Regional Hospital Centre Metz Thionville), Ayav Ahmet (University hospital of Nancy), Ortega-Deballon Pablo, (University hospital of Dijon), Lakkis Zaher (University hospital of Besançon), Liu David (University hospital Hautepierre of Strasbourg), and Deguelte Sophie (University hospital of Reims).



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Olive Oil Consumption Is Associated with Lower Cancer Mortality among Italian Adults: Prospective Results from the Moli-Sani Study and Analysis of Potential Biological Mechanisms [†]

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Keywords: olive oil; Mediterranean diet; cancer mortality; common soil

Background and Objectives: Olive oil is a key component of a traditional Mediterranean Diet and its cardiovascular health benefits have been well documented in large cohorts worldwide. However, the relationship of olive oil with cancer mortality is less robust, and it remains unclear whether the health advantages of olive oil may be accounted for by specific biological mechanisms. We therefore sought to investigate the relationship between olive oil consumption with cancer mortality in an Italian general population, and to examine specific biological pathways common to major chronic diseases as possibly underlying these associations. **Methods:** Longitudinal analysis on 22,895 men and women (mean age 55.4 ± 11.7 y) from the Moli-sani Study (enrolment 2005–2010) followed up for 12.2 years. Dietary data were collected using a semi-quantitative food frequency questionnaire, and olive oil consumption was standardized to a 10 g tablespoon (tbsp) size. Cox regression models were used to estimate hazard ratios (HRs) and 95% confidence intervals (95% CIs). **Results:** Compared with individuals who rarely consumed olive oil (≤1.5 tbsp/d), participants who had the highest consumption (>3 tbsp/d) reported 28% lower rates of cancer death (HR = 0.72; 95% CI: 0.54–0.94); a linear dose–response relationship was observed (*p* value for overall association = 0.030; *p* for non-linearity = 0.47). Higher intake of olive oil was also linked to an 18% reduced rate of mortality from any cause (HR = 0.82; 95% CI: 0.70–0.97), while the association with CVD mortality was not unequivocal (HR = 0.80; 95% CI: 0.60–1.06). Among the known risk factors analyzed, lower levels of blood pressure and resting heart rate associated with consumption of olive oil accounted for 14.5% and 8.1% of its inverse relationship with all-cause and cancer mortality, respectively. **Discussion:** Higher olive oil consumption was associated with higher survival that was largely driven by a reduction in cancer mortality, independent of overall diet quality. Known risk factors for major chronic diseases mediate such associations only in part, suggesting that other biological pathways are potentially involved in this relationship.

Author Contributions: Conceptualization, E.R. and M.B.; methodology, E.R. and A.D.C.; validation, S.C.; formal analysis, E.R.; data curation, S.C. and E.R.; writing—original draft preparation, E.R.; writing—review and editing, M.B.D., S.E., M.B. and L.I.; supervision, M.B. and L.I. All authors have read and agreed to the published version of the manuscript.

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Dose–Response Relationships of Five Dietary Patterns with the Risk of Cancer: Findings from the UK Biobank Study [†]

Solange Parra-Soto ^{1,2,*} , Katherine Livingstone ³ , Fiona Malcomson ⁴ , John Mathers ⁴, Jill Pell ⁵, Frederick Ho ⁵  and Carlos Celis-Morales ^{2,6} 



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Abstract: Diet is an important risk factor for cancer. Several approaches for assessing the nutritional quality of diets have been developed and are associated with cancer risk. However, the evidence is limited for some dietary patterns. This study investigated the associations between five dietary patterns and incident all-cause cancer. This study included 159,631 adults from the UK Biobank cohort who were free from cancer at baseline. All-cause cancer was derived from cancer registry linkage. Dietary intake was evaluated according to five dietary pattern scores: the energy-adjusted Dietary Inflammatory Index (E-DII), the Recommended Food Score (RFS), the Healthy Diet Indicator (HDI), the Mediterranean Diet Score (MDS), and the Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND). All dietary scores were categorised into tertiles, and the unhealthiest tertile for each score was used as the reference group. Cox regression was performed to investigate associations between each of the five dietary scores and all-cause cancer incidence, adjusting for sociodemographic (age, sex, ethnicity, deprivation, and income) and lifestyle (smoking status, total sedentary time, and total physical activity) factors, adiposity (BMI), and multimorbidity. After a median follow-up of 7.8 (IQR: 7.3; 10.6) years, 11,978 adults developed cancer. The RFS (HR 0.96 [95% CI 0.94; 0.98]), HDI (HR 0.96 [95% CI 0.94; 0.99]), and E-DII (HR 0.97 [95% CI 0.95; 0.99]) were inversely associated with the risk of all-cause cancer. Compared with the lowest tertile, the risk of all-cause cancer was lower for adults in the healthiest tertile for the RFS (HR 0.92 [95% CI 0.88; 0.96]), HDI (HR 0.93 [95% CI 0.89; 0.97]), and E-DII (HR 0.94 [95% CI 0.90; 0.99]). No associations were found for the MDS and MIND. A lower risk of all-cause cancer was observed with greater adherence to three of the five investigated dietary patterns (RFS, HDI, and E-DII) independent of adiposity and sociodemographic and lifestyle factors.

Keywords: cancer; diet; cohort; dietary patterns

Author Contributions: Conceptualization, S.P.-S. and C.C.-M.; methodology, S.P.-S. and C.C.-M.; software C.C.-M., F.H. and J.P.; formal analysis, S.P.-S. and C.C.-M. investigation, C.C.-M., F.H. and J.P.; writing—original draft preparation, S.P.-S.; writing—review and editing, all authors; supervision, C.C.-M., F.H. and J.P. project administration, C.C.-M., F.H. and J.P. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

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Effect of 15-Week n-3 Fatty Acid Supplementation on Inflammation and Iron Absorption in African Women Living with Overweight and Obesity [†]

Isabelle Herter-Aeberli ^{1,*} , Linda Malan ² , Mary A. Uyoga ² , Angelique Lewies ³ , Lizelle Zandberg ² , Marius Smuts ²  and Jeannine Baumgartner ⁴



Citation: Herter-Aeberli, I.; Malan, L.; Uyoga, M.A.; Lewies, A.; Zandberg, L.; Smuts, M.; Baumgartner, J. Effect of 15-Week n-3 Fatty Acid Supplementation on Inflammation and Iron Absorption in African Women Living with Overweight and Obesity. *Proceedings* **2023**, *91*, 92. <https://doi.org/10.3390/proceedings2023091092>

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Abstract: Background and objectives: Obesity is a state of chronic low-grade inflammation, which may improve with n-3 long-chain polyunsaturated fatty acid (LCPUFA) treatment in populations with low n-3 LCPUFA status. Inflammation reduces iron bioavailability by increasing hepcidin concentrations, leading to iron sequestration in macrophages and reduced intestinal iron absorption. Therefore, the objective of this study was to investigate the effects of n-3 LCPUFA supplementation on inflammatory markers and fractional iron absorption in overweight and obese individuals with chronic low-grade inflammation and a low n-3 LCPUFA status. Methods: In a single group stable iron isotope study, overweight and obese women of African descent ($n = 33$) with a BMI ≥ 28 kg/m², C-reactive protein (CRP) between 2 and 20 mg/L, Hb ≥ 11 g/dL and n-3 index $< 6\%$ were supplemented with ~ 2 g DHA/EPA daily for 15 weeks. Inflammatory markers, hepcidin, iron status indices and erythrocyte total phospholipid fatty acid composition (% of total fatty acids) were measured at baseline and endpoint. Fractional iron absorption (%) was determined by measuring erythrocyte incorporation of isotopically labelled iron (⁵⁸Fe) at the baseline and endpoint. Sample analysis is ongoing and the results, including fractional iron absorption, for all participants will be available by the time of the conference. Results: Thirty women completed the study. Their mean BMI at baseline was 36.7 ± 8.08 kg/m², they had a mean n-3 index of $4.57 \pm 0.83\%$, and median (95% CI) fractional iron absorption (FIA) was 11.8% (7.1–20.1). The n-3 index increased to $6.59 \pm 0.82\%$ ($p < 0.001$) but there was no change in FIA (9.7% (5.1–15.8), $p = 0.962$). Inflammatory status at baseline was characterized by a median (IQR) CRP of 4.15 (1.50–7.90) mg/L and alpha-1-glycoprotein of 0.99 (0.76–1.11) g/L and there was no change at endpoint. Median serum ferritin was 28.1 (12.3–71.6) μ g/L and soluble transferrin receptor was 5.9 (4.8–7.1) mg/L, resulting in body iron stores of 4.80 (0.85–6.92) mg/kg body weight. Discussion: The overweight and obese women in this study had a low n-3 index and high inflammatory status at baseline. Despite improvement of the n-3 index after 15-week supplementation, inflammatory markers and FIA did not improve at endpoint. To understand whether the improvement of the n-3 index was insufficient or the supplement dose too low requires further investigation.

Keywords: n-3 fatty acid supplementation; inflammation; obesity; iron absorption; DHA; EPA

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Data Availability Statement: After publication of the main results of the study data can be made available upon approval of a request.

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Young People's Health Interest, Nutrition Knowledge, and Views about Obesity [†]

Salma Abuznada ^{*}, Emilie Combet and Ada Garcia 



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Abstract: Background: Obesity is prevalent in young people, yet

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limited research explores young people's views regarding nutrition, health, and obesity. Objectives: The aim of this study was to explore young people's views about obesity and factors mitigating this condition. Methods: An online cross-sectional survey was distributed to UK participants aged 12–19. The survey measured views about obesity and its management (Likert scale of 1–5, 14 questions), interest in health and nutrition (Likert scale of 1–5, 2 questions), and nutrition knowledge (scored as “low” or “high” based on a threshold of giving 3 out of 6 correct answers to multiple-choice questions about nutrient sources in diet). Self-reported weight, height, and sociodemographic data were collected. Independence between variables was explored using χ^2 tests. Results: Participants ($n = 317$, median age of 16,

IQR15–18) were equally distributed between the two sexes (54% boys) and were mostly British (72%). Approximately one quarter (22%) had a BMI ≥ 30 kg/m² and most (61%) had a BMI < 25 kg/m². Participants had a high interest in health (median 4, IQR 4–5, 86% agreeing/strongly agreeing) and in the relationship between food, diet, and health (median 5, IQR 4–5, 83% agreeing/strongly agreeing). However, most participants (83%) had low nutrition knowledge. There was a relationship between interest in health (classified as interested/neutral/not interested) and sex ($p = 0.02$, 81% girls and 90% boys interested), but no relationship with BMI groups ($p = 0.5$). Over half (59%) agreed that obesity is a medical condition (median 4, IQR 3–4). There was a relationship between this agreement and sex ($p < 0.001$, 68% girls and 53% boys), but no relationship with BMI ($p = 0.9$) or nutrition knowledge ($p = 0.9$). Across the weight management options (including dieting, exercise, surgery, and medication), participants most likely agreed that combining diet and exercise is important to manage obesity (median 4, IQR 4–5, 77% agreeing/strongly agreeing). There was a relationship between this agreement and nutrition knowledge ($p = 0.04$, 75% among those with low knowledge and 90% among those with high knowledge), but no relationship with sex ($p = 0.08$) or BMI ($p = 0.9$). Discussion: In this sample representative of both sexes, obesity was generally recognised as a disease regardless of BMI or nutrition knowledge; however, sex played a role, with boys less likely to agree, despite their greater interest in health than girls. However, the sample's levels of interest in health (high) and nutrition knowledge (low) were homogenous, which limited further exploration. The influences of socioeconomic status, parental occupation, and family obesity experiences need further exploration.

Keywords: young people; obesity; views; nutrition; health

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Effectiveness of Dietary Guidelines for Reducing Free Sugar Intakes: A Randomised Controlled Trial [†]

Lucy Boxall ^{1,*} , Katherine M. Appleton ¹ , Emily Arden-Close ¹  and Janet James ² 



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

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Abstract: National dietary guidelines aim to educate and assist the public by enhancing overall diet health and decreasing health risk. Despite the widespread use of food-based dietary guidelines, assessments into their effectiveness are lacking. **Methods:** Using a randomised controlled parallelgroup trial, 242 adults (18–65 years) consuming >5% total energy intake from free sugars (FS) were randomised to receive nutrient-based (N) (n = 61), nutrient- and food-based (NF) (n = 60), nutrient-, food- and food-substitution-based recommendations (NFS) (n = 63) or no recommendations regarding free sugar intake (control, n = 58). Effects were assessed for dietary and health outcomes, with our primary outcomes being the % of total energy intake from FS (%FS) and adherence at an endpoint of 12 weeks. Participants achieving a ≥ 2% reduction in %FS from baseline or <5% %FS intakes and those that did not, were classified as adherent or non-adherent, respectively. There were no significant differences between the groups in baseline variables, with 200 participants completing dietary outcomes at week 12. Data were analysed on an intention to treat basis. Multiple regression models significantly predicted endpoint %FS (F (7, 234) = 8.86, *p* < 0.001), R² = 0.21. Significant predictors were recommendations received (B = −0.636, *p* = 0.029), baseline %FS (B = 0.377, *p* < 0.001) and baseline bodyweight (B = −0.04, *p* = 0.041). There were no significant differences at baseline %FS (mean with standard error in parentheses); control with 10.36% (0.67), N with 10.15% (0.66), NF with 10.68% (0.62), and NFS with 10.19% (0.56). The mean %FS reduced in all intervention groups, with the reduction in N, NF, and NFS being 2.47%, 3.25%, and 3.08%, respectively, in comparison to no change in the control group (−1.18%). No significant differences were found between the three intervention groups at endpoint %FS. At endpoint, adherence counts were larger in all intervention groups, N with 39; NF with 39; and NFS with 37; than the control group with 23, the reverse was observed for non-adherence with 22, 21, 26, and 35, respectively. Our results show that providing participants with N, NF or NFS dietary guidelines reduced %FS for 12 weeks. Further analyses will investigate the time course of these effects, and effects on our other outcomes.

Keywords: food-based dietary guidelines; dietary intakes; sugars; taste profiles

Author Contributions: Conceptualization, K.M.A.; methodology, L.B. and K.M.A.; software, L.B.; validation, L.B.; formal analysis, L.B.; investigation, L.B.; resources, L.B., J.J. and K.M.A.; data curation, L.B.; writing—original draft preparation, L.B.; writing—review and editing, L.B., K.M.A., E.A.-C. and J.J.; visualization, L.B.; supervision, K.M.A., E.A.-C. and J.J.; project administration, K.M.A.; funding acquisition, K.M.A., E.A.-C. and J.J. All authors have read and agreed to the published version of the manuscript.

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Development and Implementation of Food-Based Dietary Guidelines in the Slovak Republic [†]

Jana Babjakova ^{1,*} , Adela Penesova ² , Peter Minarik ^{2,3} , Daniela Minarikova ^{3,4} and Jozef Golian ⁵



Citation: Babjakova, J.; Penesova, A.; Minarik, P.; Minarikova, D.; Golian, J. Development and Implementation of Food-Based Dietary Guidelines in the Slovak Republic. *Proceedings* **2023**, *91*, 419. <https://doi.org/10.3390/proceedings2023091419>

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Abstract: Nutrition plays a fundamental role in preventing chronic non-communicable diseases and promoting overall health. In response to the absence of official dietary recommendations in the Slovak Republic, a collective of authors collaborated with state health institutions develop Food-based Dietary Guidelines (FBDGs) for adults, focusing on food groups and scientifically based information about nutrition concerning individual requirements, with consideration for the basic characteristics of the health status of the Slovak population. The FBDGs were submitted in 2021–2022, divided into two parts (general and special—Štandardný postup na výkon prevencie: “Odporúčania pre stravu a výživu u dospelých”, “Odporúčania pre stravovanie a výživu u dospelých—špeciálna časť”), and were approved by the Ministry of Health SR and integrated into standard procedures for implementing prevention, supported by a grant from the Human Resources operational program of the Ministry of Labour, Social Affairs, and Families (*Development of the new and innovative guidelines for prevention and their implementation into medical practice*). The FBDGs were methodologically prepared following the European Food Safety Authority’s (EFSA) recommendations, adapting European and non-European FBDGs to local Slovakia’s conditions. The proposal for Slovak FBDGs was the result of the consensus of the standard’s authors. The guidelines cover scientific information about various food groups, such as vegetables and fruits, starchy foods, protein-containing foods, and fats, deal with drinking regimens, and contain evidence about recommended food patterns, food hygiene, and food labelling. The recommendations emphasize the protective effects of a properly set lifestyle throughout an individual’s life, including the significance of regular and reasonably intense physical activity, stress management, proper sleeping characteristics, absence of abuses, and limiting a sedentary lifestyle. In 2023, the authors plan to prepare a third part for the recommendations as an educational publication with visual aids to enhance the food and nutritional literacy of the public. This effort aims to support individual and population health and prevent diseases in Slovakia. The guidelines will serve as a resource for health professionals, policymakers, institutions, and media, enabling the protection of health, preventive and nutritional policies and programs, and advice to improve the population’s health. By providing comprehensive guidelines, the FBDGs will contribute to reducing the occurrence and consequences of chronic non-communicable diseases in the Slovak Republic.

Keywords: dietary guidelines; nutrition; prevention; adults; Slovak Republic

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Keywords: food-based dietary guidelines; dietary intakes; sugars; taste profiles

Author Contributions: Conceptualization, K.M.A.; methodology, L.B. and K.M.A.; software, L.B.; validation, L.B.; formal analysis, L.B.; investigation, L.B.; resources, L.B., J.J. and K.M.A.; data curation, L.B.; writing—original draft preparation, L.B.; writing—review and editing, L.B., K.M.A., E.A.-C. and J.J.; visualization, L.B.; supervision, K.M.A., E.A.-C. and J.J.; project administration, K.M.A.; funding acquisition, K.M.A., E.A.-C. and J.J. All authors have read and agreed to the published version of the manuscript.

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Development and Implementation of Food-Based Dietary Guidelines in the Slovak Republic [†]

Jana Babjakova ^{1,*} , Adela Penesova ² , Peter Minarik ^{2,3} , Daniela Minarikova ^{3,4} and Jozef Golian ⁵



Citation: Babjakova, J.; Penesova, A.; Minarik, P.; Minarikova, D.; Golian, J. Development and Implementation of Food-Based Dietary Guidelines in the Slovak Republic. *Proceedings* **2023**, *91*, 419. <https://doi.org/10.3390/proceedings2023091419>

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Abstract: Nutrition plays a fundamental role in preventing chronic non-communicable diseases and promoting overall health. In response to the absence of official dietary recommendations in the Slovak Republic, a collective of authors collaborated with state health institutions develop Food-based Dietary Guidelines (FBDGs) for adults, focusing on food groups and scientifically based information about nutrition concerning individual requirements, with consideration for the basic characteristics of the health status of the Slovak population. The FBDGs were submitted in 2021–2022, divided into two parts (general and special—Štandardný postup na výkon prevencie: “Odporúčania pre stravu a výživu u dospelých”, “Odporúčania pre stravovanie a výživu u dospelých—špeciálna časť”), and were approved by the Ministry of Health SR and integrated into standard procedures for implementing prevention, supported by a grant from the Human Resources operational program of the Ministry of Labour, Social Affairs, and Families (*Development of the new and innovative guidelines for prevention and their implementation into medical practice*). The FBDGs were methodologically prepared following the European Food Safety Authority’s (EFSA) recommendations, adapting European and non-European FBDGs to local Slovakia’s conditions. The proposal for Slovak FBDGs was the result of the consensus of the standard’s authors. The guidelines cover scientific information about various food groups, such as vegetables and fruits, starchy foods, protein-containing foods, and fats, deal with drinking regimens, and contain evidence about recommended food patterns, food hygiene, and food labelling. The recommendations emphasize the protective effects of a properly set lifestyle throughout an individual’s life, including the significance of regular and reasonably intense physical activity, stress management, proper sleeping characteristics, absence of abuses, and limiting a sedentary lifestyle. In 2023, the authors plan to prepare a third part for the recommendations as an educational publication with visual aids to enhance the food and nutritional literacy of the public. This effort aims to support individual and population health and prevent diseases in Slovakia. The guidelines will serve as a resource for health professionals, policymakers, institutions, and media, enabling the protection of health, preventive and nutritional policies and programs, and advice to improve the population’s health. By providing comprehensive guidelines, the FBDGs will contribute to reducing the occurrence and consequences of chronic non-communicable diseases in the Slovak Republic.

Keywords: dietary guidelines; nutrition; prevention; adults; Slovak Republic

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Negative Dietary Practices among 7-Year-Old Schoolchildren in Bulgaria †

Vesselka Duleva * , Ekaterina Chikova-Iscener, Lalka Rangelova and Plamen Dimitrov



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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Maintaining a balanced diet and regular exercise is especially important for first graders. Poor nutrition compromises the quality of life, school attainment, and growth and sets suboptimal dietary habits later in life. The aim of the present study is to assess negative dietary practices among first graders in Bulgaria. Methods: A cross-sectional survey of a nationally representative sample of 3051 7-year-old students was conducted in 2019. The research was carried out in strict compliance with the protocol developed by the WHO (World Health Organization) as part of the WHO European Childhood Obesity Surveillance Initiative (COSI). As part of the study, a questionnaire was presented to the families of the first graders to assess the frequency of food consumption by the children. Results: A quarter (25.3%) of the students did not consume breakfast on a daily basis. The majority did not eat fresh fruits (62.9%) and vegetables every day, excluding potatoes (66.3%). Furthermore, 18% of the children consumed dairy products less than once a week or never. Additionally, 14.8% had fruit juice every day. One-fifth (19.7%) of the students drank soft drinks most of the days or every day of the week (>4 days/week). Many children never consumed or consumed less than once a week protein-rich foods like meat (8.9%), fish (62.3%), eggs (26.4%), and legumes (25.9%). Most days or every day of the week (>4 days/week), a quarter (24.2%) of the children had salty snacks like chips, and half of them (49.7%) had sweet snacks like candies and cakes. Discussion: The results of the present study clearly demonstrate a suboptimal dietary model for first graders in Bulgaria. Only one-third of the children consumed fresh fruits and vegetables daily. The frequency of intake of soft drinks and salty and sweet snacks is too high. The frequency of consumption of protein-rich foods like fish, eggs, and legumes is suboptimal. First graders should become a special target group for policymakers in Bulgaria.

Keywords: dietary practices; schoolchildren

Author Contributions: Conceptualization, V.D. and E.C.-I.; methodology, P.D.; software, E.C.-I.; validation, V.D., L.R. and P.D.; formal analysis, V.D.; investigation, E.C.-I.; resources, P.D.; data curation, L.R.; writing—original draft preparation, E.C.-I.; writing—review and editing, V.D., L.R. and P.D.; visualization, E.C.-I.; supervision, V.D.; project administration, V.D.; funding acquisition, V.D. All authors have read and agreed to the published version of the manuscript.

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Gender Differences in Adherence to Dietary Recommendations and Guidelines among Community-Dwelling Older Italian Adults [†]

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Matteo Cotta Ramusino ^{3,5} and Federica Prinelli ^{1,2} 



Citation: Conti, S.; Bernini, S.; Perdixi, E.; Jesuthasan, N.; Costa, A.; Cotta Ramusino, M.; Prinelli, F. Gender Differences in Adherence to Dietary Recommendations and Guidelines among Community-Dwelling Older Italian Adults. *Proceedings* **2023**, *91*, 413. <https://doi.org/10.3390/proceedings2023091413>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Adhering to healthy dietary guidelines plays an essential role in maintaining population health, but data on older people exploring the gender dimension are scarce. We aimed to investigate the gender differences in adherence to dietary recommendations among an Italian population of older men and women. Methods: We included participants aged ≥ 65 years from the cross-sectional NutBrain study, recruited in 2019–2023 in northern Italy. Dietary habits were assessed using a 102-semi-quantitative food frequency questionnaire. Adherence to recommendations was allocated for the intake of 23 food groups as described in the Italian Healthy Eating Guidelines-CREA. Variables were dichotomized as 0 = no adherence and 1 = adherence. The ‘Italian Dietary Recommendations Adherence Score (IDRAS)’ was calculated as an indicator of overall adherence to the dietary guidelines, by summing up each food group and then dividing them into tertiles. We compared the adherence to the recommendations and the IDRAS between men and women using the Chi-squared test. Results: A total of 802 participants were analysed (mean age 73.4 years \pm 6.2 SD, 59.2% women, 60.3% at least high education). Consumption of legumes (67.5%), fish (51.4%), bread (66.7%), milk and yoghurt (71.8%), fruit and vegetables (63.0%), and water (56.7%) was significantly lower than recommended values in the total sample. In contrast, consumption of cheese (54.1%), animal fats (54.0%), sweets and snacks (90.9%), red (54.0%) and processed meat (84.2%), and bakery products (85.9%) exceeded the recommendations. Women were more likely than men to meet the recommendations for non-alcoholic (70.5% vs. 57.8%) and alcoholic beverages (81.1% vs. 51.4%), red (32.8% vs. 26.3%) and processed meat (18.3% vs. 12.2%), potatoes (65.3% vs. 57.8%), and sugars (70.5% vs. 62.7%) and less likely to meet the recommendations for bread (26.3% vs 42.8%) and pasta (60.2% vs 64.5%). Overall, only 19,3% had high adherence to IDRAS (highest tertile); women had higher adherence than men (22.1% vs 15.3%). Discussion: Overall adherence to recommendations was low in the total sample, with women more likely than men to adhere to recommended dietary guidelines. Identifying gender differences in dietary intake and adherence to dietary recommendations is crucial for tailoring interventions and improving population nutrition strategies.

Keywords: dietary guidelines; gender differences; older adults; population health; cross-sectional study

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Estimating Usual Intakes Affecting the Macronutrient and Micronutrient Distribution among the Adolescent Population: A Study of Slovenian National Dietary Surveys SI.Menu 2017/18 [†]

Hristo Hristov ^{1,*} , Rok Poličnik ² , Matej Gregoric ² , Masa Hribar ¹  and Igor Pravst ¹ 



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Abstract: Estimating the dietary intakes of certain populations is essential for making the right decisions on a national level in respect to nutrition, epidemiology, economic, environmental, and policy applications. The objective of this study is to determine the usual dietary intakes of macronutrients and micronutrients, considering how the population are individually affected by food and nutrient intakes. From the Central Register of Population, employing a two-stage stratified sampling procedure, a representative sample of adolescent participants was randomly selected, according to sex and place of residency. Two non-consecutive 24 h dietary recalls were collected using a web-based Open Platform for Clinical Nutrition (OPEN) software. Additionally, a food propensity questionnaire was used to collect information about a participant's frequency of food consumption. A total of 468 adolescent were included in the analyses: 10–12 years old (N = 194), 13–14 years old (N = 93), and 15–17 years old (N = 181). The analyses reveal dietary patterns that were different both between age groups and between genders. An overall lower variability in energy and fat intakes but a much higher variability for micronutrients was observed. Unbalanced usual dietary intakes were especially represented through high consumptions of foods that are high in sugar as well as fresh and processed meats, and low intakes of legumes and legume products, fruits and vegetables, while a higher variability was detected within dairy products. Determining the usual dietary intake using the Multiple Source Method provided wider intake distributions that allowed for more precise estimates for the prevalence of inadequate/excessive intakes for analyzed subpopulations. The overall results suggest a deviation from national dietary guidelines and a call for public health interventions in order to improve dietary patterns.

Keywords: adolescents; dietary survey; 24-h recall; FPQ; usual dietary intake; multiple source method; macronutrients and micronutrients; food groups; Slovenia

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Author Contributions: Conceptualization and writing H.H. and R.P.; H.H. prepared the data and carried out the data analyses; M.G., M.H. and I.P. critically reviewed the content; M.G. and I.P. were responsible for assuring the funding of the study. All authors have read and agreed to the published version of the manuscript.

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Genetic Risk Factors Modulate the Association between Physical Activity and Colorectal Cancer [†]

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Abstract: Physical activity (PA) is an established protective factor for colorectal cancer (CRC). However, the mechanisms underlying this relationship are less understood, and it is not known if the association is modified by genetic variants. To investigate this possibility, we conducted a genome-wide gene–PA interaction analysis. Using logistic regression and two-step and joint tests, we analyzed the interactions between common genetic variants across the genome and self-reported PA (categorized as active vs. inactive and as study- and sex-specific quartiles) in relation to CRC risk. PA had an overall protective effect on CRC, showing a 15% risk reduction among active vs. inactive participants (OR = 0.85; 95% CI = 0.81–0.90). The two-step GxE method identified an interaction between rs4779584, an intergenic variant located between the GREM1 and SCG5 genes, and PA for CRC risk ($p = 2.6 \times 10^{-8}$). Stratification by genotype at this locus showed a significant reduction in CRC risk by 20% in active vs. inactive participants with the CC genotype (OR = 0.80; 95% CI = 0.75–0.85), but no significant PA–CRC association was observed among CT or TT carriers. When PA was modeled as quartiles, the 1-d.f. GxE test identified that rs56906466, an intergenic variant near the KCNG1 gene, modified the association between PA and CRC ($p = 3.5 \times 10^{-8}$). Stratification at this locus showed that increase in PA (highest vs. lowest quartile) was associated with a lower CRC risk solely among TT carriers (OR = 0.77; 95% CI = 0.72–0.82). In summary, these results identified two genetic variants that modified the association between PA and CRC risk. One of them, related to GREM1 and SCG5, suggests that the bone morphogenetic protein-related, inflammatory and/or insulin signaling pathways may be associated with the protective influence of PA on colorectal carcinogenesis.

Keywords: physical activity; gene-environment interaction; colorectal cancer; GWAS

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Dietary Studies, Guidelines and Recommendations: Exploring Solutions to Folate Deficiency in the United Kingdom—Parsnips as a Case Study for Dietary Intervention [†]

Annabelle Somers ^{1,2,*} , Jenny Baverstock ¹, Philip Calder ³, Frances Gawthrop ⁴, Eleftheria Stavridou ² and Guy Poppy ¹

United Kingdom—Parsnips as a Case Study for Dietary Intervention.

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Abstract: One in six British teenagers is clinically deficient in folate. A growing body of evidence suggests that this could be negatively impacting their short- and long-term health, with folate deficiencies being linked with conditions such as depression, colorectal cancer, and Alzheimer's disease. To address this, there is a need to identify cost-effective, culturally appropriate, and sustainable interventions to improve folate intakes across the UK. This project explores how the root vegetable parsnip could be better utilised to help improve folate

intake in vulnerable populations. To understand the effects of genetics and growing conditions on nutritional quality, a microbiological assay has been used to explore the variation in folate content among different parsnip cultivars. This information will be combined with HPLC-based investigations of changes in folate content with storage, processing, and digestion to determine the difference between a parsnip in the field and a parsnip as it is purchased

and consumed. In parallel, the adequacy of micronutrients provided in food system leverage points, such as school meals and hospital food, will be evaluated by analysis of recipes and meals. This will be compared to the UK government-recommended nutrient intake values to investigate whether sufficient micronutrients are being delivered in these settings. These research work packages will be combined to investigate whether the micronutrient content of meals provided in food system leverage points would be improved by the incorporation of more root vegetables, such as parsnips. Our research shows that the quantity and quality of folates in parsnip are affected by variation from farm to fork, including the variety grown, the length of storage, and how the parsnips are cooked before consumption. All of these factors should be taken into consideration when evaluating whether increased parsnip consumption could be implemented in food system leverage points like school meals to address folate deficiency in the UK. The same issues are likely to be the case for a range of other fruit and vegetables, and using the framework established with parsnip, the utility of other food-based interventions for addressing micronutrient insecurity in the UK can be assessed.

Keywords: food security; food systems; micronutrient deficiency; folate; *Pastinaca sativa*; parsnip

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Portion Size Recommendations in Food-Based Dietary Guidelines: A Global Review of the Methods [†]

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Abstract: Over the past decades, increased food intakes have contributed to rising obesity rates. This worldwide phenomenon partly results from the consumption of larger portion sizes. In this context, food-based dietary guidelines (FBDGs) have been described as an essential public health tool to guide populations toward achieving a healthier and balanced diet and reducing the risk of non-communicable diseases. Recent literature has underlined the wide variability in portion size recommendations as a future challenge to the derivation and success of FBDGs and has highlighted the need for common standard portions. This review aims to report the recommended portions of nine common food groups within existing FBDGs for the general adult population. The methods used to derive recommended portion sizes are also compared, including the type and scope of data used and the statistical approaches applied. The government-endorsed food-based dietary guidelines listed by the Food and Agriculture Organisation (FAO) were analysed, as well as their related scientific reports. Results from 99 FBDGs show that several countries ($n = 11$) promote the consumption of a variety of foods, without providing further reference quantities for daily food intake or portion size. Furthermore, some guidelines ($n = 13$) derive recommendations from local or national food consumption surveys, which may not necessarily align with appropriate or recommended intakes. When used, statistical methods for the derivation of recommended portions combine diverse criteria, including reported dietary habits (median food type/group intakes) and recommended levels of macronutrients and micronutrients of concern in the population. The inconsistencies in methodological approaches reflect uneven access to relevant dietary data, which in turn seems to drive the observed variability. This review informs the reader of the range and sources of variability in food group portion size recommendations across countries and constitutes a basis for the future elaboration of a global methodological framework to derive harmonised reference portions.

Keywords: food-based dietary guidelines; portion size

Author Contributions: Conceptualization, F.S., E.R.G., A.L.E. and T.N.M.; methodology, F.S. and E.R.G.; validation, E.R.G.; investigation, F.S.; writing—original draft preparation, F.S.; writing—review and editing, E.R.G., A.L.E. and T.N.M.; supervision, E.R.G., A.L.E. and T.N.M. All authors have read and agreed to the published version of the manuscript.

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Walnut Consumption Reduces Perceived Stress and Improves Mood States in a Sample of Young Adults: A Randomized Cross-Over Trial [†]

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and Francisco José Pérez-Cano ^{1,4} 



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Abstract: The relationship between psychological health and diet is bidirectional. As such, nutritional interventions can improve mood and wellbeing due to the complex interaction between nutrient intake and the gut–brain axis. Walnuts contain a number of potentially neuroactive compounds (e.g., tryptophan, serotonin, melatonin) that could have a potential effect on mood and wellbeing among the general population. Therefore, the present study sought to determine the effect of walnuts on perceived stress, mood states, and wellbeing. **Methodology:** A total of thirty young adults (aged 24.0 ± 4.2 years; 90% women) participated in an 18-week randomized crossover trial (NCT04799821). All the participants completed two randomized crossover protocols: intervention (daily consumption of 40 g of walnuts for 8 weeks) and control (refrain from walnuts or any other nuts for 8 weeks). After 2 weeks of washout, the two groups followed the intervention/control in reverse order. Baseline data were collected for perceived stress, mood states, and wellbeing. In addition, spot urine samples were collected at baseline for the determination of 5-hydroxy-3-indol acetic acid (urine serotonin metabolite). Data were collected once more at the end of the 8-week intervention and control periods. **Results:** After an 8-week intervention, daily walnut consumption significantly reduced perceived stress ($p = 0.008$) and improved certain mood states, such as anger–hostility and fatigue–inertia ($p = 0.026$ and $p = 0.010$, respectively). Furthermore, levels of serotonin’s metabolite were higher ($p = 0.035$) in the urinary samples of the intervention group, whilst no differences were shown between the baseline and control trials. **Discussion:** Our results show that daily walnut consumption has a significant impact on serotonin levels, and this could be associated with improved mood and stress states. However, more evidence is needed to explain the mechanisms underlying this association.

Keywords: walnuts; mood; food; stress; 5-hydroxy-3-indol acetic acid

Author Contributions: Conceptualization, M.F.Z.-R. and M.I.-P.; methodology, M.F.Z.-R., F.J.P.-C.; Data acquisition, M.F.Z.-R., A.I.-P. and M.I.-P.; data curation, M.F.Z.-R. and A.I.-P.; writing—original draft preparation, M.F.Z.-R.; writing—review and editing, M.I.-P.; project administration, M.I.-P.; funding acquisition, M.F.Z.-R. and M.I.-P. All authors have read and agreed to the published version of the manuscript.

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Walnut Consumption Improves Sleep Quality: A Randomized Controlled Trial [†]

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Abstract: Diet and sleep are two factors intrinsic to health which influence each other. For instance, diet may influence sleep via melatonin and its biosynthesis from tryptophan. Experimental data exist indicating that the provision of specific foods rich in tryptophan or melatonin can improve sleep quality. Walnuts are nutrient-dense foods that have a unique nutritional profile, including tryptophan and melatonin. However, clinical trials are needed to confirm the causal impact of walnuts on sleep and elucidate the underlying mechanisms. Therefore, our aim was to determine whether the daily consumption of walnuts could have a positive impact on sleep quality. **Methodology:** In this randomized cross-over trial (NCT04799821), 80 young adults (24.1 ± 3.9 years; 85.5% women) either ingested 40 g of walnuts daily (intervention) or refrained from eating walnuts or any other nuts (control) for 8 weeks, with a washout period of 2 weeks. The outcome variables included sleep quality, measured with actigraphy (duration, latency, wake after sleep onset (WASO), awakenings, and efficiency), daytime sleepiness (Epworth Sleepiness Scale), and the melatonin metabolite, 6-sulfatoxymelatonin (6-SMT), which was determined in urine samples collected (a) from 20:00 to 23:00 and (b) from 23:00 to 7:00. **Results:** The 8-week intervention with walnuts was significantly associated with an improvement in sleep quality ($p = 0.033$). Notably, the intervention was significantly associated with lower sleep latency ($p = 0.003$), higher sleep efficiency ($p = 0.022$), and less daytime sleepiness ($p = 0.004$). Furthermore, at the end of the intervention, the concentration of 6-sulfatoxymelatonin in urine samples from 20:00 to 23:00 was significantly higher ($p = 0.024$), whilst no differences were shown between the baseline and control conditions. **Discussion:** These data suggest that a daily serving of 40 g of walnuts provides an increase in melatonin which can be beneficial in improving sleep quality and in reducing daytime sleepiness in healthy young adults. However, more studies are needed to explain the mechanisms underlying this association.

Keywords: sleep quality; walnuts; 6-sulfatoxymelatonin

Author Contributions: Conceptualization, M.F.Z.-R. and M.I.-P.; methodology, M.F.Z.-R. and F.P.C.; data acquisition, M.F.Z.-R., A.I.-P. and M.I.-P.; data curation, M.F.Z.-R., A.I.-P., M.D.-H. and T.C.; writing—original draft preparation, M.F.Z.-R.; writing—review and editing, M.I.-P.; project administration, M.I.-P.; funding acquisition, M.F.Z.-R. and M.I.-P. All authors have read and agreed to the published version of the manuscript.

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Do Statin Users Adhere to Dietary Recommendations for Cardiovascular Disease Prevention? †

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Abstract: Emerging evidence suggests that there is an interplay between the effects of diet and lipidlowering therapy in primary and secondary prevention of cardiovascular disease. All prevention strategies focus on modifiable risk factors, with special attention on dietary behavior. Lifestyle and dietary recommendations usually precede or accompany the prescription of statins. However, there is limited evidence of patients' adherence to dietary recommendations. The aim of this study was to investigate the dietary behavior of statin users, taking into account the intake of specific food groups. Data on clinical, demographic, health, and lifestyle factors were collected using a series of interviewer and self-completion questionnaires. Food group intake was calculated using 24 h dietary recalls for three non-consecutive days. The average daily intake for each subject was calculated as the mean of the three 24 h recalls. Food groups of interest included vegetables, fruits, grains, protein foods, and dairy products. Data were analyzed for 30 participants aged > 40 years. Patients with hypertension, diabetes, and current smokers represented 90%, 17%, and 27% of the study population, respectively. Almost 65% of the patients had a history of ischemic heart disease and were eligible for the secondary prevention of cardiovascular events. Mean daily dietary intake was 3.8 servings of protein, 4.1 servings of grains, 1.7 servings of vegetables, 1.4 servings of fruit, and 1.2 servings of dairy products. Red and processed meats contribute 50% of total protein intake and are the main source of protein in the patients' diets. In terms of grain consumption, only one-quarter of intake comes from wholegrain products. The reported consumption of fruits and vegetables ranged from 1.6 to 5.9 servings per day, but still, their average intake was below the recommendation of 4.5 servings per day. However, at the individual level, 20% of the study population met the fruit and vegetable consumption recommendations. The obtained results suggest sub-optimal dietary behaviors in people undergoing chronic statin therapy. Thus, public health efforts, along with ongoing diet monitoring, are definitely needed to improve the current knowledge on the impact of massive dietary habits on the overall health of cardiovascular patients.

Keywords: prevention; statin; dietary intake; food groups; recommendations

Author Contributions: Conceptualization, B.D. and M.O.; methodology, M.Z.C. and I.B.; software, J.K.-S.; formal analysis, M.Z.C. and J.K.-S.; investigation, M.Z.C. and I.B.; writing—original draft preparation, M.Z.C.; writing—review and editing, M.Z.C. and V.T.; visualization, V.T.; supervision, M.Z.C. and I.S. All authors have read and agreed to the published version of the manuscript.

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Concept for Preventive Strategy through Optimizing the Nutrition of Pregnant Women in Bulgaria [†]

Peter Markov ¹, Irina Markova ² and Donka Baykova ^{3,*}



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Abstract: Background: Healthy nutrition of pregnant women is a powerful factor for reducing health risks during this period and for the outcome of pregnancy. The objective of the present work is to establish a preventive strategy for pregnant women in Bulgaria by means of a physiologically based nutritional model created upon national and international expert recommendations. Methods: Sociological and documentary methods were used. Results and discussion: The presented strategy concept includes 7 “steps” in the construction and individualization of nutritional regimes for pregnant women by medical professionals. The first step involves the quantitative satisfaction of the women’s increased nutritional energy needs (compared to non-pregnant women of the same age). During the first trimester, women require the following: +70 kcal/day; second trimester: +260 kcal/day; third trimester: up to +500 kcal/day. The second step involves increasing the intake of high-quality protein; during the first trimester, women require +1 g/day; second trimester: +9 g/day; third trimester: +28 g/day. For the third step, fats and carbohydrates do not require additional supplements during pregnancy. For the fourth step, a physiologically justified increase in vitamin and mineral food intake is necessary. As a percentage, the increase is as follows: vitamins A and E: +8%; C and B12: +11%; B1, B2 and niacin (B3): +30%; B6: +46%; A: +60%; folate (B9): +81%; copper: +15%; iodine: +33%; iron and zinc: +50%. The fifth step involves the selection of medico-biological criteria for proper nutrition: weight gain: from 11.5 to 16 kg in healthy women with normal body mass (BMI from 18.5 to 24.9) before the beginning of pregnancy. Overweight women (BMI from 25 to 29.9) should not gain more than 7 to 11 kg; obese women (BMI over 30) should not gain more than 6 to 8 kg; underweight women (BMI < 18.5) should not gain more than 12.5 to 18 kg. The sixth step involves performing a medical assessment for pregnancy-related health problems. The seventh step includes the development of practical recommendations for a healthy diet with a set of products adapted to the specific metabolic needs of the pregnant women and distribution of food intake during the day. Conclusion: The experts in this field should provide medical professionals (involved in the healthcare of pregnant women) with the necessary skills and techniques to implement this preventive strategy in their counseling practices.

Keywords: strategy; optimization; nutrition; pregnant women

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Sugar Replacers in Confectionary beyond Sugar-Free Chewing-Gums: Demonstration of Oral Health Benefits of Polyols in Tablets Using a Customized-Reversed pH-Telemetry Test [†]

Caroline Perreau , Daniel Wils and Clémentine Thabuis *



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sugar-free chewing-gum (SFCG) were largely described in the literature. In addition to the increase in salivary flow and the mechanic effect of CG, their main ingredient, i.e., polyols, can also have some specific benefits on oral health on their own. Some have been shown to have a bacteriostatic effect on acid-producing bacteria, and others have been shown to be particularly active on dental plaque early colonizers, resulting in both a reduction in dental caries prevalence or a decrease in gums inflammation. Here, we aimed to demonstrate these positive effects using the tablet vector only composed of compressed polyols. **Methods:** We used a customized inversed pH-telemetry test that is often used to demonstrate the “safe for teeth” characteristics of a food product. This inversed pH-telemetry test was designed to evaluate the potential of a food product to counteract the dental plaque drop in pH following a sucrose challenge, according to the regulatory advised test. It was performed on five healthy volunteers that grew 5-day dental plaque over a micro electrode to measure their pH in situ. Three different tablets were tested: 100% maltitol versus 100% sorbitol versus control tablets (70% starch + 30% resistant dextrin). **Results:** For each tablet, a neutralization score was calculated as the difference in the pH values (pH values at the end of the consumption of the respective tablets—pH value just before consumption of the tablets). Positive values indicate a neutralization (increase in pH during the consumption of the product), meaning that the neutralization with maltitol tablets was the greatest among tested tablets ($p = 0.003$ vs. control). Sorbitol tablets also had a significant impact ($p = 0.01$ vs. control). **Discussion/Conclusions:** This inversed pH-telemetry was designed to show a neutralizing effect of polyol tablets as it has been conducted with sugar-free chewing-gums. We demonstrated here that tablets were also able to counteract the dental plaque pH drop induced by a sucrose challenge, showing clearly that tablets should also be considered as oral health beneficial products. Consequently, the consumption of polyols in various vectors should be regulatory, as is recommended for SFCG.

Keywords: polyol; oral health; sweetener

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Data Availability Statement: Data available on request due to restrictions of privacy, legal and ethical reasons.

Conflicts of Interest: Clémentine Thabuis, Caroline Perreau and Daniel Wils are employees of Roquette.

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Public Procurement of Food Products in Educational Institutions in Slovenia [†]

Neža Fras ¹, Evgen Benedik ^{2,3,*} and Matej Gregoric ^{~ 1}



[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Citation: Fras, N.; Benedik, E.; Gregoric, M. Public Procurement of Food Products in Educational Institutions in Slovenia. *Proceedings* **2023**, *91*, 369. <https://doi.org/10.3390/proceedings2023091369>

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Abstract: Background and objectives: Kindergartens and schools are an important consumer of food in Slovenia nationwide, and they are obliged to the public procurement of food. The aim of this study was therefore to investigate the consideration of nutritional criteria in public food procurement (PFP) and to identify differences in PFP according to the type, size, and region of the educational institution (EI). Methods: In 2021, a total of 535 Slovenian EIs completed a self-administered questionnaire on nutrition-related practices. The use of nutrition criteria and various practices in the PFP was also assessed. To assess statistically significant differences ($p \leq 0.05$), we performed non-parametric Fisher's exact and chi-square tests. Results: In the requirements of the last public tender of food, EIs mainly considered the conditions related to food quality schemes (92.5%), organic production (83.6%), and adequacy of nutritional value (72.2%). When implementing school meals, they were least likely to fully comply with restrictions on the allowable inclusion of foods with low nutritional value (38.5%) and most likely to comply with recommendations on the frequency of the inclusion of recommended foods (47.0%). Most of the EI respondents (74.0%) confirmed that the criteria based on nutrient profiling would be useful for more healthy food products procurement. More requirements on the inclusion of organic production and nutritional adequacy were found among kindergartens than schools. Statistically significant differences in nutritional quality were found between smaller and larger EIs. More requirements on the inclusion of organic production, quality classes, and nutritional adequacy were found among larger compared to smaller EIs. Differences were also found between EIs from three different regions for the inclusion of organic production requirements. Discussion: Healthy PFP policies can improve access to nutritious and healthy food in EI and promote healthy eating habits. The implementation of the healthy PFP was achieved differently at distinct levels. The presented evaluation suggests that different success in implementation might be attributed to different characteristics of individual EI. System changes might also be needed to support and improve the implementation of healthy PFP policies.

Keywords: public food procurement; educational institutions; school nutrition; nutrient profiling; criteria for nutritionally more suitable food products

Author Contributions: Conceptualization, E.B. and M.G.; methodology, E.B. and M.G.; validation, E.B. and M.G.; investigation, N.F.; writing—original draft preparation, N.F.; writing—review and editing, E.B. and M.G.; visualization, N.F.; supervision, E.B. and M.G.; project administration, M.G.; funding acquisition, M.G. All authors have read and agreed to the published version of the manuscript.

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Meeting UK Fibre Intake Recommendations in Food Insecure Households: The Availability of Fibre from Redistributed Surplus Food

Neil Boyle ^{1,*} , Flora Larcombe ², Katie Adolphus ¹, Nick Wilkinson ² , Fiona Croden ¹ and Louise Dye ¹



Belgrade, Serbia, 14–17 November 2023.

Citation: Boyle, N.; Larcombe, F.; Adolphus, K.; Wilkinson, N.; Croden, F.; Dye, L. Meeting UK Fibre Intake Recommendations in Food Insecure Households: The Availability of Fibre from Redistributed Surplus Food.

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Abstract: Background: The majority of UK adults are failing to consume the recommended fibre intake levels. Whilst insufficient fibre intake is shown across the population as a whole, it is particularly deficient in low-income households. The cost-of-living crisis has further exacerbated the prevalence of food insecurity, with an increasing number of UK households becoming reliant on redistributed food to supplement their diets. The availability of fibre from this redistributed food is unknown. Objectives: To examine the quantities and sources of fibre available to food insecure households via surplus food redistribution. Methods: 12 months of food processed by a UK surplus food charity was examined to quantify the availability of fibre (grams per 2000 kcal) redistributed to food insecure populations in Leeds. These data were also examined to identify seasonal variation in fibre sources, food groups providing most fibre content, and to quantify the number of ‘sources of’ (SO) and ‘high in’ (HI) fibre foods as a proportion of total food items redistributed. Results: The recommended portion of 30g of fibre per 2000 calories was available for redistribution for 3 out of 12 months in 2022. However, this was due to the sporadic availability of specific individual high fibre snack items, rather than reflective of the balance of diet commonly available. Frequently received SO/HI fibre foods were not donated in large quantities, required complex cooking, or were not nutritionally balanced. There was no seasonal variation in fibre sources evident. Discussion: Redistribution of surplus food can provide critical support to food insecure households. The nutritional balance of this food is largely dependent on the types of foods available for redistribution, so fluctuations in fibre availability is expected. Whilst insufficient to meet the recommended 30g/day of fibre, the food available for redistribution was sufficient to meet and exceed the levels of fibre commonly consumed in the general population (~20 g/day). Insight into the quantity and types of fibre-rich foods available for redistribution can: (i) inform specific interventions (e.g., recipe ideas) to increase the consumption of these available foods, (ii) help identify which types and sources of fibre are not commonly available and should be prioritised.

Keywords: fibre; surplus food; diet quality; low income households; food poverty

Author Contributions: Conceptualization, N.B., F.L., L.D. and K.A.; methodology, N.B., F.L. and L.D.; formal analysis, F.L.; investigation F.L.; data curation, F.L.; writing—original draft preparation, N.B., F.C. and F.L.; writing—review and editing, All; supervision, N.B., L.D., F.C. and K.A.; project administration, N.B. and F.L.; funding acquisition, L.D., N.B. and K.A. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: Restrictions apply to the availability of these data. Data were obtained from Fareshare Yorkshire and access to these data are subject to the approval of Fareshare Yorkshire. The authors can be contacted to facilitate reasonable requests.

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A Mini Review on the Effects of Experimental Design, Including Variations in Participant Baseline Performance, When Testing the Efficacy of Polyphenol Consumption to Enhance Mood and Cognitive Function in Humans from a New Researcher Perspective [†]

Duaa Altuwairki ^{1,*} and Kirsten Brandt ² 



Citation: Altuwairki, D.; Brandt, K. A. Mini Review on the Effects of Experimental Design, Including Variations in Participant Baseline Performance, When Testing the Efficacy of Polyphenol Consumption to Enhance Mood and Cognitive Function in Humans from a New Researcher Perspective. *Proceedings* **2023**, *91*, 344. <https://doi.org/10.3390/proceedings2023091344>

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: This review discusses the implications, from a new researcher’s perspective, of variations in the design, dose and participant age group used and their subsequent effects on the cognitive performance and mood observed in studies investigating the effect of foods rich in phenolic compounds. In this context, ‘new researchers’ design and conduct new exploratory research on this topic, such as testing novel products for these properties. Previous systematic reviews and meta-analyses have concluded that foods rich in phenolic compounds have an enhancement effect on cognition, providing a motive for exploring the benefits of different types of foods with such constituents; however, these benefits were inconsistent across the studies. This has prompted the present review to assess the literature to elucidate the potential causes of the variability in outcomes. One source of variation was inconsistency in the cognitive assessment tools used across studies. Another was participant age, where the positive effects were seen more in elderly populations than in a healthy young population with a high baseline performance. Also, the frequent absence of primary outcome identification and other indications of a less cautious approach to statistical analyses may have contributed to instances of type 1 errors. In conclusion, new researchers should use well-validated assessment tools, study populations with a modest baseline performance, and predefined appropriate statistical procedures to minimize irreproducible outcome variations.

Keywords: experimental design; predefined outcomes; reproducibility; effect size

Author Contributions: Conceptualization, methodology, investigation, writing—original draft preparation, D.A.; writing—review and editing, supervision, K.B. All authors have read and agreed to the published version of the manuscript.

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Assessment of Vitamin D Intake and Status in Slovenian Premenopausal and Postmenopausal Women [†]

Vid Vic¹, Petra Pavlic¹, Valentina Rok¹, Saša Kugler², Andreja Kukec^{1,2} and Ruža Pandel Mikuš¹



Belgrade, Serbia, 14–17 November 2023.

Citation: Vic¹, V.; Pavlic¹, P.; Rok, V.; Kugler, S.; Kukec, A.; Mikuš, R.P. Assessment of Vitamin D Intake and Status in Slovenian Premenopausal and Postmenopausal Women. *Proceedings* **2023**, *91*, 333. <https://doi.org/10.3390/proceedings2023091333>

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Abstract: Background and objective: The main source of Vitamin D is the synthesis of cholecalciferol (D3) from 7-dehydrocholesterol in the skin when exposed to ultraviolet radiation. A significant intake can be obtained from supplementation and fortified foods and to a lesser extent from fatty fish and eggs. The objective of our study was to assess vitamin D intake and status in Slovenian premenopausal and postmenopausal women. Methods: A cross-sectional study was conducted between March and May 2021, involving 319 women aged 44 to 65 years. After considering exclusion criteria and the completeness of data, 176 participants were included in the final analysis. Vitamin D status was determined by measuring the concentrations of total 25-hydroxyvitamin D (25(OH)D), vitamin D-binding protein (DBP), and albumin and by calculating bioavailable and free 25(OH)D. Vitamin D intake from fish (fatty and lean separately), eggs, and food supplements or drugs was assessed using a vitamin D-focused food frequency questionnaire (FFQ). In addition, sun exposure, menstrual status, socio-demographic characteristics, and health status were assessed. Results: Vitamin D insufficiency (total 25(OH)D < 75 nmol/L) was observed in 77% of premenopausal and 62% of postmenopausal women. Premenopausal women had 12% lower total 25(OH)D and 32% lower bioavailable 25(OH)D compared to postmenopausal women. The average milk and yoghurt consumption was 135 ± 161 mL/day; egg consumption was 3.2 ± 2.4 eggs/week. The mean vitamin D intakes from food and supplementation were 2.2 ± 1.3 µg/day and 21.7 ± 26.2 µg/day, respectively. In total, 61% of the participants supplemented with a mean dose of 35.4 ± 25.3 µg/day, with no statistically significant differences between premenopausal and postmenopausal women. The odds ratio (OR) for vitamin D insufficiency (25(OH)D < 75 nmol/L) among participants who did not supplement with vitamin D was 6.23; *p* ≤ 0.001. Premenopausal women had a statistically non-significant lower supplementation rate. Discussion and conclusions: Vitamin D status among Slovenian postmenopausal women is significantly more favourable than among premenopausal women. Despite a high supplementation rate, vitamin D insufficiency is still present in the majority of the population. With limited milk consumption, milk fortification alone is not feasible. However, egg biofortification could offer a viable contribution to increasing vitamin D intake.

Keywords: vitamin D; 25(OH)D; postmenopausal; premenopausal; epidemiological study

Author Contributions: Conceptualization, V.V., A.K., and R.P.M.; investigation: V.V., P.P., V.R. and S.K.; writing: V.V. and S.K.; reviewing: V.V., A.K., R.P.M., P.P., V.R. and S.K.; supervision: A.K. and R.P.M. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

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


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The VEGANScreener Project: The Protocol for the Clinical Observational Study [†]

Tooba Asif ^{1,*}, Stefaan De Henauw ¹, Jan Godja ² , Anna Ouradova ², Selma Kronsteiner Gicevic ³,
Willem De Keyzer ¹ and Ainara Martinez Tabar ⁴



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Abstract: Background and Objectives: Consumption of plant-based diets, including vegan diets, requires attention towards diet quality and the early detection and prevention of nutritional deficiencies. The VEGANScreener project aims to develop and validate a standardized brief web- and app-based screening tool to assess and monitor diet quality among vegans in Europe. To this end, a clinical study will be performed to evaluate the VEGANScreener against a reference diet assessment method and nutritional biomarkers. Materials and Methods: An observational cross-sectional study will comprise six hundred participants across four European sites (Germany, Spain, Belgium, Czech Republic): 400 self-reported vegans (≥ 2 years on vegan diet) and 200 self-reported omnivore controls; without diseases affecting the metabolism and intestinal integrity; aged 18 to 65 years (1:1 ratio 18–35 and 36–65); males and females (1:1 ratio). Subjects will be enrolled after an online eligibility check. Informed consent will be obtained, and the subjects enrolled will be given a unique ID (pseudonymized). The initial clinical visit consists of structured medical history-taking, blood pressure, heart rate and anthropometric measurements, blood, spot urine and saliva sampling, distributing the VEGANScreener access, diet record instructions, and general survey access. A follow-up collection visit will be scheduled 14–21 days apart: 24 h urine and 4-day diet records will be collected, and subjects' participation will be terminated. VEGANScreener will be administered twice to limit the within-person errors. Results: Field work is ongoing, and we expect to have results by the time of the conference. Discussion: The VEGANScreener tool will be validated for the target population. The primary objective is to assess the construct validity and criterion validity of the VEGANScreener through associations of the score with nutrient intakes from a 4-day diet record and associations with biomarkers of dietary intake. Standard statistical models will be implemented for cross-sectional comparisons of geographical groups. Secondary outcomes will include analyses of dietary data and metabolomics. Vegan subgroups will be identified with dimensionality reduction methods and univariable statistical tests. Major nutrient sources and variations across groups will be assessed. Exploratory metabolomic analysis (blood, urine, saliva) to identify novel concentration biomarkers of dietary intake and nutritional adequacy will be performed using multivariable analysis.

Keywords: plant-based diets; vegan diets; diet quality; nutritional deficiencies; VEGANScreener project; web-based screening tool; app-based screening tool; diet assessment; nutritional biomarkers; nutritional adequacy

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29/3); the German Funding Foundation DFG (Germany, project no. 01EA2202), and the Spanish Ministry of Science and Innovation-EU Next Generation Funds (Spain, project no. AC21_2/00015).

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Institutional Review Board Statement: The study will be conducted in accordance with GCP and the declaration of Helsinki. The study protocol was approved by the following institutional review boards: KVUH ethical board (EK-VP03/0/2022), UNAV (2022.120), IFPE (AZ 37/23), UGent (ONZ-2023-0169), Cantonal Ethic Committee Zurich (2023-01112).

Informed Consent Statement: Informed consent will be obtained from all subjects involved in the study.

Data Availability Statement: Data sharing is not applicable to this abstract.

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The Updated Algorithm of Front-of-Pack Label Nutri-Score Is Not in Line with Dutch Food-Based Dietary Guidelines: Results of Calculations with Dutch Food Composition Database [†]

Jacco Gerritsen ¹, Hans Verhagen ² and Stephan Peters ^{1,*}



Keywords: Nutri-Score; front-of-pack label; algorithm; food-based dietary guidelines; wheel of five

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Background and objectives: The front-of-pack label Nutri-Score has met a lot of scientific opposition. In the Netherlands, these were major concerns that Nutri-Score was not in line with the Dutch food-based dietary guidelines. In 2022, the algorithm behind the Nutri-Score was updated with the intention to bring it more in line with the general European food-based dietary guidelines. **Methods:** In this study, the renewed 2022 algorithm for solid foods is applied to the Dutch Food Composition Database (NEVO) to calculate the Nutri-Score values. Subsequently, the Nutri-Score values of all-solid foods were compared to the Dutch food-based dietary guidelines (the Wheel of Five). The foods that are included in the Wheel of Five are considered as “healthy”, i.e., would qualify for labels A or B, while the foods that receive labels C/D/E are considered “unhealthy”. **Results:** In total, 1980 solid foods were selected from NEVO. Despite the intended outcome, 19% of the unhealthy (non-Wheel of Five) products still received a Nutri-Score A or B. In addition, 25% of the healthy products in the Wheel of Five were scored as “unhealthy”, i.e., Nutri-Scores C/D/E. So grossly, circa one quarter of the foods will be wrongly labelled if the new algorithm is applied. **Discussion:** If the Nutri-Score is applied with the updated algorithm, this will mean that an average supermarket in the Netherlands will contain thousands of products with an inappropriate score. These results confirm the worries of the >200 Dutch food scientists and the associations of dietitians, life style coaches and weight councilors that the Nutri-Score will confuse Dutch consumers upon introduction. In their request to the Dutch Ministry of Health, they suggest to first bring the Nutri-Score essentially in line with our Wheel of Five before introducing the Nutri-Score system in the Netherlands. The full details of this work can be found at doi 10.13140/RG.2.2.23262.31043.

Author Contributions: J.G.: Conceptualization; Data curation; Formal analysis; Methodology; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. H.V. and S.P.: Methodology; Validation; Visualization; Roles/Writing—original draft; Writing—review & editing. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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Conflicts of Interest: J.G. and S.P. are employed at the Dutch Dairy Association. H.V. is an independent consultant at the Food Safety & Nutrition Consultancy (The Netherlands) and holds professorships at the Technical University of Denmark (Denmark) and the University of Ulster (Northern Ireland). No author has a past or current collaboration with the Nutri-Score. H.V. is a member of the international board of the Choices International Foundation since 2023. Until 2015, Both S.P. and H.V. were members of the independent scientific committee in the Netherlands supporting the former front-of-pack logo “het Vinkje”. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The Dutch Dairy Association is involved in the national discussion in the Netherlands about front-of-pack logos by submitting inputs into product reformulations and front-of-pack consultations of the Dutch Ministry of Health, Welfare and Sport.

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Exposure to Dietary Salt through Nutrition in Public Preschools in Belgrade [†]

Dunja Koprivica ^{*}, Vesna Pantic[´]-Palibrk, Maja Ristic[´], Stefanija Nikolic[´] and Danica Stošic[´]



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Abstract: Background: Widespread overconsumption of food high in salt is linked to various adverse health conditions. Children are especially susceptible and exposed to these nutritional trends. Nutrition within preschool facilities is an important influence in adopting healthy dietary habits at an early age. Belgrade public preschools provide daily meals for around 50,000 children. As they are of recognized importance, nutritional requirements for preschools in Serbia are set out by regulations. The Institute of Public Health of Belgrade conducts continuous surveillance of nutrition in public preschools in Belgrade. Objective: To gain insight in to an important aspect of nutrition, i.e., the food served in public preschools in Belgrade. Method: Analysis of data, i.e., results of chemical–bromatological analysis of meals sampled in public preschools in Belgrade from 31 January 2018 to 31 December 2022. Statistical analysis was conducted using IBM SPSS 22.0. Results: Overall, 3917 whole day meals (comprising breakfast, lunch and snack) were analyzed for salt content (NaCl). Meal samples were taken from two age groups—1 to 3 years ($n = 1351$) and 4 to 7 ($n = 2566$). The findings of the study show that the average salt content across the observed period exceeded the upper values set by the regulation in both age groups— 3.57 ± 1.17 g in the 1-to-3-years age group and 4.54 ± 1.12 g in the 4-to-7-years age group. Less than 5% of tested samples had a salt content within the defined limits (around 4.9% in both age groups). Seasonal variations in salt content in meals have been determined as well as significant statistical differences between the years of the observed period. Discussion: A positive trend is observed in terms of a gradual, discrete reduction in salt in preschool meals throughout the observed period. As joint efforts at the local level show moderate improvements, further actions are needed with the inclusion of other stakeholders (state authorities, industry, etc.) with the aim of providing the healthiest diet for children attending preschools.

Keywords: preschool nutrition; salt; surveillance

Author Contributions: Conceptualization, D.K. and V.P.-P.; methodology, D.K.; formal analysis, D.K.; resources, D.K. and D.S.; data curation, D.K., M.R., S.N. and D.S.; writing—original draft preparation, D.K.; writing—review and editing, V.P.-P. and M.R.; visualization, D.K.; supervision, V.P.-P. All authors have read and agreed to the published version of the manuscript.

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Assessment of the Salt Content in Breads in Slovenia [†]

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Abstract: Background and objectives: Reducing salt intake is among the most cost-effective measures for reducing the burden of non-communicable diseases. To effectively reduce intake, salt reduction strategies often concentrate on food categories that contribute the most to overall salt intake. In Slovenia, bread is recognized as one of the contributors to salt intake and efforts are being made to reduce its salt content. Therefore, the objective of this study was to assess the current salt content of bread sold in large retail shops and smaller bakeries in Slovenia. Methods: The study was conducted in November/December 2022. A total of 178 bread samples were purchased across 11 statistical regions of Slovenia, both in large retail shops and smaller bakeries. The sampling in large retail shops covered all main bread categories and considered statistical consumption data. The final sample included 60 white wheat breads, of which 28 were purchased in large retail shops. Other categories included mixed wheat (N = 33), dark wheat (N = 16), half-white wheat (N = 12), and rye bread (N = 3). The sampling in smaller bakeries was limited only to white and wholegrain bread, where available. Sodium content was determined by inductive coupled plasma mass spectroscopy (ICP-MS). Salt content was calculated by multiplying it by 2.54, assuming that all sodium corresponded to sodium chloride (NaCl). Results: The average salt content of white wheat bread sold in large retail shops was 1.21 ± 0.16 g NaCl/100 g. The average salt content of dark wheat, half-white, and mixed bread was similar (1.15 ± 0.14 g NaCl/100 g, 1.23 ± 0.13 g NaCl/100 g, and 1.22 ± 0.24 g NaCl/100 g, respectively). On the other hand, wheat bread from smaller bakeries had an average salt content of 1.34 ± 0.21 g NaCl/100 g (range 0.85–2.06 g/100 g). Discussion: The results suggest a slight reduction in the average salt content of mixed wheat, dark wheat, half-white wheat, and rye bread from large retail shops, compared to a study conducted in 2010. These findings emphasize the importance of ongoing efforts to improve the composition of bread and the need for continued focus on salt reduction strategies.

Keywords: bread; salt content; ICP-MS

Author Contributions: Conceptualization, S.K., U.B., H.H. and I.P.; methodology, H.H. and I.P.; formal analysis, H.H.; investigation, H.H. and I.P.; data curation, H.H.; writing—original draft preparation, S.K.; writing—review and editing, S.K., U.B., H.H. and I.P.; supervision, U.B. and I.P.; funding acquisition, I.P. All authors have read and agreed to the published version of the manuscript.

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Dietary Patterns of Serbian Adults 10–74 Years Old: Serbian National Food Consumption Survey Following EU Menu Methodology [†]

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Abstract: Background and objectives: Increasing rates of adult overweight (60.7% population) and diet-related cardiovascular diseases (52% population) in Serbia alarmingly call for a change in dietary patterns. To be able to identify problems and solutions, harmonized and comparable food consumption data are needed. The European Food Safety Authority (EFSA) provided support and guidance, through the EU Menu program, for conducting the Serbian National Food Consumption Survey on adults from 10 to 74 years old, including pregnant women and vegetarians in the period of 2017–2022. This work gives an overview of the quantity, energy intake, and distribution across different food groups, which are all basic parameters of dietary patterns, aiming at comparing the actual diet with recommendations—the EAT Lancet Commission Report. Methods: Food consumption data were collected from 3018 participants: 856 adolescents aged 10–17 years, 1155 adults aged 18–64 years, 581 elderly subjects aged 65–74 years, 145 pregnant women, and 281 vegetarians, using two inconsecutive days repeated 24 h dietary recall. The advanced nutritional software, Diet Assess and Plan (DAP), was applied for data storage, processing, and reporting, while the Serbian Food composition database was used as a resource for food composition information of the foods and recipes consumed in the survey. Results: In the adult population, quantitatively, the most consumed foods are as follows: vegetable and vegetable products (312 g/day), milk and milk products (247.7 g/day), fruit and fruit products (245.7 g/day), grain and grain products (215.8 g/day), and meat and meat products (166.08 g/day). Liquids—water and non-milk beverages—were consumed 1511 g/day on average. However, the mean distribution of energy intake differs significantly. The main source of energy comes from grain and grain products (637.5 kcal/day (29.3%TE)), meat and meat products (355.4 kcal/day (16.3%TE)), fats and oils (271 kcal/day (12.4%TE)), and milk and milk products (261.3 kcal/day (12%TE)). Discussion: The energy distribution and consumed quantities of some food groups indicate that actual diet, comprised of processed grains, meat, and fatty food, is not meeting reference healthy diet recommended in EAT Lancet Commission Report, and present a risk factor for the development of overweight, obesity, and diet-related cardiovascular diseases in the Serbian population.

Keywords: food consumption; dietary patterns; EU menu; nutritional inadequacy

Author Contributions: Conceptualization, J.M. and M.G.; methodology, M.G., M.Z., J.M.; software, M.G.; validation, I.Š., I.K., M.K. and M.Z.; formal analysis, J.M.; investigation, J.M.; I.Š., M.K., M.Z., I.K., V.S., resources, M.G.; data curation, J.M.; writing—original draft preparation, J.M.; writing—review and editing, I.Š.; visualization, J.M.; supervision, M.G.; project administration, M.Z.; funding acquisition, M.G. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Restrictions apply to the datasets: The datasets presented in this article are not readily available because the data are part of an ongoing study. Requests to access the datasets should be sent to jelena.milesevic@imi.bg.ac.rs.

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Utility of a Qualitative, Dietary ‘Self-Monitor Your Diet’[®] Diary to Improve Diet Quality and Compliance with Dietary Recommendations[†]

Lidia Wadolowska Academic Editors: Sladjana Sobajic
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10-719 Olsztyn, Poland; lidia.wadolowska@uwm.edu.pl[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background/objectives: No matter how simple dietary recommendations are, many people find it difficult to follow them in the long run. This study tested the utility of a qualitative, dietary diary, entitled ‘Self-Monitor Your Diet’[®], in order to improve diet quality and compliance with dietary recommendations. Methods: The sample consisted of 84 university females (Poland), aged 20.4 ± 2.0 years. To monitor food consumption, the ‘Self-Monitor Your Diet’[®] was used. The diary contains eleven food items, including six items recommended for consumption and five items with limited consumption, along with the recommended consumption frequencies per day/week/month. The respondents completed the diary for two consecutive months (M1; M2). The average daily consumption frequency (times/day) of each food item was calculated. The respondents’ adherence to the dietary recommendations was expressed as an Adherence Score (AdhS) in points (range 0–12), with one point per compliance to each recommendation. More points were awarded for better compliance with dietary recommendations. Body Mass Index (BMI) and waist-to-hip ratio (WHtR) were calculated on the basis of measurements taken twice (before the diary completion and after 2 months). Results: For the M1 diary, AdhS within 0–2 points were found in 9% of respondents, 2–4 points in 36%, 4–6 points in 42%, 6–8 points in 12%, and 8–10 points in 1%. For the M2 diary, more subjects fell in higher ranges of AdhS: 4%, 36%, 38%, 20%, 2%, respectively ($p = 0.0009$). AdhS for the M2 diary averaged at 4.1 points (SD 1.7), and, for the M1 diary, 3.8 points (SD 1.8) ($p > 0.1$). More subjects consumed fruit/vegetables ≥ 5 times/day in M2 than M1 (50% vs. 1%, respectively; $p < 0.0001$) and sweetened beverages/energy drinks \leq once a week (61% vs. 42%, respectively; $p = 0.0061$). There were no differences in the average BMI or WHtR between the first and second data collections. Discussion/conclusions: The diary, based on the user’s own



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activity, can be useful in monitoring day-by-day dietary habits and promoting diet quality improvement, especially with respect to fruit and vegetables.

Keywords: diet monitoring; dietary recommendation; diet-related diseases; food frequency consumption; food-based dietary guidelines

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Contribution of Plant-Based Dairy and Fish Alternatives to Iodine Nutrition in the Swiss Diet—A Swiss Market Survey [†]

Isabelle Herter-Aeberli * and Zulekha Khalil



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conventional dairy and fish products are major sources of iodine, along with iodized salt. However, the growing popularity of plant-based alternatives may impact the iodine supply of the population. This study aimed to comprehensively assess the iodine content in plant-based dairy (milk, yogurt, and cheese) and fish alternatives available in the Swiss retail market and compare them with conventional dairy and fish products. **Methods:** In 2022, a market survey was conducted in Zurich, Switzerland, to identify the plant-based dairy and fish alternatives available in major retail outlets, online grocery stores, and health food stores. Product information from a total of 477 plant-based alternative products was recorded. Iodine content in unfortified alternatives was factorially calculated using the nutritional composition of plant ingredients listed in the Swiss Food Composition Database. To further comprehend the impact of plant-based alternatives on iodine consumption, we modelled dietary scenarios by substituting the intake of dairy and fish items with plant-based alternatives, based on the recommendations of the Swiss Food Pyramid. **Results:** Out of the 477 products identified, 58% were organic products. Only 4 out of 170 milk alternatives were iodine fortified (mean iodine concentration: 22.5 µg/100 mL), and there were no yogurt, cheese, or fish alternatives that were iodine fortified. The median iodine concentration in unfortified plant-based alternatives was negligible compared to conventional dairy and fish products (milk: 0.21 vs. 9.5 µg/100 mL; yogurt 0.36 vs. 6.1 µg/100 g; cheese: 0.10 vs. 20 µg/100 g; fish 0.50 vs. 44 µg/100 g). Three portions of dairy per day as recommended by the Swiss Food Pyramid provide 25% of the RDA (150 µg/day), whereas substituting three portions of dairy per day with unfortified alternatives provides only 0.7% of the RDA for iodine. **Discussion:** Only 4 out of 170 plant-based milk alternatives are iodine-fortified in the Swiss market, while no fortified yogurt, cheese, or fish alternatives are available. Thus, the risk of the consumers to miss out on the ca. 25% of the RDA for iodine by consuming plant-based alternatives is high, placing them at a risk for inadequate iodine intake.

Keywords: plant based alternatives; milk; dairy; fish; iodine; fortification

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Trends in Sweetness of the Diet in the United Kingdom: 2008/9 through 2018/19 [†]

Inga Kutepova ^{1,*}, Alison Kamil ², Alissa R. Wilson ¹ and Colin D. Rehm ³



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challenging, some organizations have suggested reducing the consumption of all sweet-tasting foods and beverages, regardless of the source of the sweet taste (i.e., caloric or low/no calorie sweeteners (LCSs)), due to the assumed correlation between dietary sweetness and sugars intake. Descriptive data summarizing patterns and trends in the overall sweetness of the diet may help inform dietary recommendations. For this cross-sectional study, dietary information was collected from 15,655 participants aged ≥ 1.5 year, as part of the National Diet and Nutrition Survey Rolling Programme (NDNS RP) over the course of four consecutive days between 2008/09 and

2018/19. Products that were sweetened with LCS were matched to their sugar-sweetened equivalents (e.g., a regular beverage with sugars and a diet beverage with LCS). The amount of sweetness in an individual's diet was quantified in terms of grams of ASE (approximate sugar equivalent) per day. During the study period, the ASE of the diet declined by approximately 10%. The estimated ASE of the diet per 2000 calories was 96.7 g/d for children and 113.8 g/d for adults. Approximately one-fifth of the total ASE was from LCSs. There was evidence of a non-linear trend over time, with ASE levels remaining relatively stable between 2008/09 and 2014/15, and then declining. The amount of ASE coming from LCS sources increased, going from 8g/d to 12.6 g/d. The overall change in total sugars and ASE was more apparent for beverages compared to foods (ASE values decreased by 20.7% for beverages vs. 4.4% for foods), but both decreased significantly. In the UK, there has been a shift in both the overall sweetness of the diet, as well as the total amount of sugars consumed. This is partly attributable to the reformulation of products, as well as changes in preferences among consumers. According to the findings of this study, the sweetness levels in the diets of the UK population are declining over time.

Keywords: sweetness; sweeteners; cross-sectional studies; trends; United Kingdom; the National Diet and Nutrition Survey

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Abstract: Reducing sugars consumption is an important public health priority. Because reducing one's sugar intake is

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Dietary and Supplement Intake of Lutein and Zeaxanthin: How Much Do We Get and How Much Do We Need? [†]

Susan Hazels Mitmesser * , Qian Ye, Prasad P. Devarshi and Ryan W. Grant



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Abstract: Background and objectives: Lutein and zeaxanthin (L+Z) are carotenoids

highly concentrated in the macula to maintain macular pigment optical density (MPOD) throughout the lifespan. Studies have shown that an intake of 6–20 mg or higher of L+Z would be beneficial for visual function and cognition. The human body cannot synthesize L+Z and must obtain them from other sources.

Objective: To determine the nutrient intake status of L+Z in US children (6–18 years) and adults (19–64 years), and how dietary supplements contribute to the total intake level of L+Z. **Methods:** Data from NHANES 2003–08 cycles were used to estimate the mean intakes of L+Z from food and food + supplements (F+S). Children and adults were analyzed according to age groups: 6–8 years, 9–13 years, and 14–18 years for children, and 19–30 years, 31–50 years, and 51–64 years for adults. **Results:** In adults ($n = 8252$), the mean (SE) dietary intake of L+Z from food was 1.322 mg (0.040), which was similar to the intake from F+S: 1.396 mg (0.041). For both adult men and women, the mean intake increased by age, with the lowest intake of 1.047 mg (0.039) from food in adult women aged 19–30 years, and the highest intake of 1.700 mg (0.069) from F+S in adult men aged 51–64 years. In children ($n = 7429$), the mean (SE) intake of L+Z was 0.743 mg (0.026) from food, and 0.748 mg (0.026) from F+S. The intake levels among all age groups in children were similar, with the lowest intake of 0.686 mg (0.028) from food in girls 14–18 years, and the highest intake of 0.801 mg (0.038) from F+S in boys 9–13 years. **Discussion:** We found that the dietary intake levels of L+Z in US were much lower than levels recognized to support brain and eye health. Supplementation only marginally increased the total intake, which may indicate a lack of consumer awareness. Efforts are needed to raise public awareness of the health benefits of L+Z and encourage more consumption of L+Z-containing food (dark leafy greens and yellow or orange fruits/vegetables) and supplements by establishing dietary guidance for L+Z. This research was funded by Pharmavite LLC.

Keywords: lutein; zeaxanthin; NHANES; nutritional status; dietary intake; supplement; children; adults; visual; cognition

Author Contributions: Conceptualization, S.H.M., Q.Y. and R.W.G.; methodology and analysis, Q.Y. and P.P.D.; data interpretation, S.H.M., Q.Y. and R.W.G.; writing, review, and editing, S.H.M., Q.Y., P.P.D. and R.W.G. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest: Pharmavite, LLC sponsored the study. S.H.M. Q.Y., P.P.D. and R.W.G. are employees of Pharmavite, LLC.

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Nutritional Adequacy and Protein Intake in Older Adults at Risk of Undernutrition with Subjective Memory Decline Enrolled in the Protein-Enriched Mediterranean Diet, with or without Exercise (PROMED-EX) Trial [†]

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Abstract: Older adults are vulnerable to undernutrition, resulting in weight loss and adverse health outcomes, including a loss of independence and a lower quality of life. Adequate protein intake is particularly important for the maintenance of muscle health during ageing. The UK population reference intake for protein (0.75 g/kg/day) may not be sufficient to counteract the reduced responsiveness of older skeletal muscle to anabolic stimulus. Research suggests that 1.2 g/kg/day of protein may be optimal, considering distribution (25–30 g/meal) and leucine-rich sources typically found in animal protein, especially for those at high nutritional risk. PROMED-EX is a randomised controlled trial testing a PROtein-enriched MEDiterranean Diet, with or without Exercise on nutritional status and memory, in older adults (60+) at risk of undernutrition, with subjective memory decline. The current aim is to determine the baseline nutritional adequacy of adults enrolled in PROMED-EX. Participants completed 4-day food diaries at baseline. Diaries were analysed for energy and nutrients using Nutritics. Nutritional adequacy was determined by comparing sex- and age-specific UK dietary reference values (DRVs). Protein intake was also compared to higher recommended DRVs for older adults. Fifty participants (60% female; age 67 ± 6.0 years; BMI: 23.5 ± 2.8 kg/m²) were included. Insufficient energy intake in men (1803.4 ± 510.7 kcal/d) and women (1776.2 ± 508.7 kcal/d) in the sample, with 22.0% meeting the energy DRVs. The risk of nutrient inadequacy was highest for fibre and vitamin D, with almost all failing to meet the DRVs. Less than 50% met nutritional adequacy for vitamin A, iodine, iron, magnesium, potassium, and selenium. Over 35% had suboptimal intakes for selected B vitamins (niacin, folate) and calcium. Most (82%) of the sample achieved the UK protein target of 0.75 g/kg/day, with only 34% meeting the higher 1.2 g/kg/day target. The mean protein intake was less than optimal for breakfast (12.3 ± 7.0 g) and lunch (17.1 ± 8.8 g), accounting for 17.3% and 24.1% total daily protein intake, and highest at dinner time (48.2%) at 34.3 ± 18.3 g. The primary protein contributors were 'cereals' (15.7%), followed by 'dairy' (14.9%), 'processed meat' (10.9%), 'poultry' (10.8%), and 'red meat' (10.5%). Increasing protein intakes at breakfast and lunch alongside leucine-rich sources could help achieve the optimal protein intake. The nutrient-dense PROMED-EX intervention may be beneficial for this at-risk population with suboptimal nutrient intakes.



Keywords: undernutrition; subjective cognitive decline; dietary reference values; older adults; protein

Author Contributions: C.T.M. and N.A.W. drafted the manuscript. All authors (C.T.M., N.A.W., L.B., L.C.P.G.M.d.G., F.P., D.V., J.V.W.) contributed to the editing of the manuscript and revising it critically for intellectual content. The Trial Steering Committee approved this manuscript submission. All authors have read and agreed to the published version of the manuscript.

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Simple Model for Estimating the Dietary Intake of Dietary Fibre [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Dietary fibre is an essential part of healthy human nutrition. However, due to the changes in the definition of dietary fibre in 2009, we are still struggling to update the data about dietary fibre content as

data obtained with methods that include all dietary fibre components are scarce. This problem is transferred to nutritional studies worldwide and impairs the quality of monitoring the dietary intake of dietary fibre. The aim of our work was to develop a simple yet acceptably accurate model for dietary fibre intake based on analytical data. Based on the national study SI.Menu 2017/2018 we collected the frequency of food items eaten in the food groups that contribute the most to dietary fibre intake. From these groups, the most frequent foods were selected and analysed for dietary fibre content using AOAC methods 991.41 and 2011.25. After obtaining the results, the data were used in our “forced choice” model. The model was created on the data of food intake for 392 people. The cumulative intake of six food groups (vegetables, fruits, grains and grain products, potato and potato products, legumes and nuts) was known; therefore, we could calculate the share of each food selected to the total food group intake. Having calculated the daily intake for each food, analytical data were applied. This allowed us to calculate the daily intake of dietary fibre. The calculated daily intake was 17.6 g/day using data obtained with the AOAC 991.43 method. The daily intake estimated with data obtained with the AOAC 2011.25 method was 34.3 g/day. In order to evaluate our model, the daily intake of dietary fibre was compared with that in another study based on the same population. Our estimation based on 45 food items was only 10.6% lower than the estimation based on all food items reported by people included in the other study. Therefore, we conclude that our simple model can provide a rough estimate based on analytical data and can serve as a good tool to update research on the daily intake of dietary fibre.

Keywords: dietary fibre; intake; model; AOAC 2011.25; AOAC 991.43

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A Review of Food-Based Dietary Guidelines: Are Iconographies Representing Sustainability? [†]

Ornella Tiboni-Oschilewski, Beatrice Biasini * , Alice Rosi , Francesca Merloni, Benedetta Merloni and Francesca Scazzina

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Abstract: Background and objectives: The food-based dietary guidelines (FBDGs) are primarily intended to promote healthy diets, and little is known about specific references to the multidimensional aspects of sustainability in their iconographies. Therefore, the objective of this study is to review the existing FBDGs iconographies according to the four sustainability dimensions (nutrition-health, socio-cultural, environmental, and economic) and evaluate to what extent these tools include different sustainability indicators. Methods: FBDGs were collected from the FAO repository and government's official websites in January 2023. Only the latest FBDG editions targeting the general population were included in the study. Non-governmental iconographies addressing macrogeographical areas were also analysed. Sustainability indicators ($n = 30$) were chosen from a preliminary literature review from the four sustainability dimensions. Visual analysis was performed. Results: In total, 191 iconographies were found. The health dimension was the most represented, being present in all iconographies with at least one indicator, followed by the socio-cultural dimension. The environmental dimension was present in 29.8% of the iconographies, while the economic dimension was the least mentioned (1.6%). Globally, the main health indicators were diet diversity (99%), healthy lifestyle (79%), and the avoidance of critical nutrients (71%). Culinary practices (76%) and traditional products (71%) were the most represented within the socio-cultural pillar. Only three iconographies included affordability/costs to consumer as an economic indicator. Those indicators that no iconography mentioned were related to food consumption outside the home, gender, migrants, and fair trade. The more recent the iconography, the greater the presence of sustainability dimensions and indicators. Higher-income countries had a greater presence of health and environmental sustainability indicators, while lower-income countries highlighted more socio-cultural and economic aspects. Discussion: These results are consistent with those retrieved from the literature analysing the main FBDG documents, but present new and complementary information. As the practicality, affordability, availability, and access to healthy and sustainable foods are the main barriers to compliance with dietary guidelines, more focus should address these factors. These results offer an opportunity for technicians and policymakers for adding more sustainability aspects to improve the iconographies while keeping them easy and intuitive.

Keywords: food-based dietary guidelines; healthy and sustainable diets



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Evaluation of the Emergency Meal Kitchen Menus Meeting the Daily Nutritional Requirements [†]

Osman Güldemir

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Abstract: On 6 February 2023, two major and subsequent aftershocks were experienced in Kahramanmaraş, in Türkiye. In these earthquakes, disasters occurred in the provinces of Kahramanmaraş, Hatay, Gaziantep, Osmaniye, Malatya, Adana, Diyarbakır, Şanlıurfa, Adıyaman and Kilis. More than 40,000 people lost their lives. The day after the earthquakes, disaster/emergency kitchens were created in these cities through the initiatives of various institutions and organizations. One of these kitchens is “Anadolu Cuisine”, where Anadolu University operated until 2023. Every day, approximately 15,000 people benefited from the emergency kitchen located in the Belen district of Hatay. In the study, the task of meeting the daily requirements of adults who eat at this kitchen was evaluated. For this, the breakfast, lunch, and dinner menus served in the emergency kitchen were followed on site by the researcher for a week, examining the amounts offered to one person. Then, the energy and nutritional values of the menus were calculated using the nutrition information system. Then, these values were evaluated using the Türkiye Nutrition Guide 2022 reference values. As a result, the energy intake of adults fed from the emergency kitchen was found to be sufficient; it has been determined that the recommended daily intake of important minerals and vitamins such as calcium and vitamin E, D, C cannot be met. In addition, it has been observed that the daily water consumption of individuals is insufficient. Moreover, to all these factors, it has been understood that those with chronic diseases have difficulties in accessing the special foods they need. In such crisis situations, it is recommended to develop strategies for community nutrition and to implement them with immediate coordination.

Keywords: earthquake; disaster kitchen; crisis kitchen; disaster nutrition; soup kitchen; nutrition assessment; energy intake; nutritional value; daily intake; food consumption



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Vitamin D and Cardiovascular Disease Risk: Using Outcomes to Guide Future Nutrition Science [†]

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Abstract: Despite positive associations between micronutrient intake, status, and health outcomes, many randomized controlled trials (RCT) of vitamins are null. Standards to establish causality in biological systems include the Bradford Hill criteria, the experimental component of which relies on and promotes RCT-centred approaches. Such criteria may need adaptations to the specificities of nutrition science. Our objective, as part of a broader FENS initiative to improve the science of nutrition, was to conduct a case study to assess the Bradford Hill criteria (BHC) applied to clinical studies of vitamin D and cardiovascular disease endpoints and evaluate strengths and pitfalls for this approach. We conducted a systematic review of the recent literature on CVD and vitamin D supplementation, including both RCT, cohort studies (CT), or systematic reviews within Medline,

Web of Science, and Cochrane libraries. Studies had to be conducted in adults, including hard CVD-relevant endpoints with a minimum sample size of $n = 500$ for RCT and $n = 10,000$ for CT. CT had to utilize quality-assured, analytical methods for serum 25-hydroxyvitamin D assessment and include verified clinical outcomes. We also evaluated and proposed plausible biochemical and physiological mechanisms for vitamin D and CVD. We graded the evidence according to BHC for the establishment of causality in biological systems and the identification of strengths and pitfalls of this approach. The search yielded 4170 papers, and 31 met the predefined criteria. The criteria “strength of association”, “consistency”, “temporality”, “biological gradient”, “plausibility”, “experiment”, “specificity”, “analogy”, and “coherence” were analyzed and appraised. While the logical framework of the BHC is perceived as useful, its direct applicability to the nutritional context is partly open to interpretation and could be further specified. The Bradford Hill criteria for establishing causality need adaptation for the nutritional context and to the advances in biological and social sciences in the last decades. Insights gained and methodological paradigms identified may have broad application to nutrition science.

Keywords: Nutritional Science; Vitamin D; Cardiovascular Disease; Bradford Hill criteria

Author Contributions: Conceptualization, D.M., L.B., M.K. and J.W.; methodology, D.M, L.B., M.K. and J.W.; formal analysis, D.M., L.B., M.K. and J.W.; data curation, J.W.; writing—original draft preparation, D.M.; writing—review and editing, L.B., M.K. and J.W. All authors have read and agreed to the published version of the manuscript.

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Evaluating Affordability of Healthier Diets in Four African Countries [†]

Joaquin Ameller Pavez ^{1,*}, Sophie Droque ¹, Kaleab Baye ², Marie-Josophe Amiot ¹, Noora Kanerva ³, Agnes Le Port ⁴, Marinel Hoffman ⁵, Abdelrahman Lubowa ⁶, Gaston Ampe Tumuhimbise ⁷, Mikael Fogelholm ³ and Natalia Rosa-Sibakov ⁸



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Abstract: Between 702 and 828 million people around the world were affected by hunger in 2021.

The prevalence of undernourishment relentlessly continues to affect the world, and particularly SubSaharan Africa (23.2% in 2021). Exacerbated inequalities across and within countries are undermining the nutritional adequacy and affordability of diets and threatening vulnerable groups including children under five years of age and women of reproductive age. This research presents a diet optimization approach where the objective is to evaluate the nutritional adequacy and affordability of diets across 4 African countries, namely Ethiopia, Kenya, South Africa and Uganda. The targeted population includes dyads of women of reproductive age and their children between 6 and 24 months. The mathematical programming approach allows for the theoretically contrasting of optimal outcomes of the model with data from food consumption surveys in primary and secondary cities of each country. Based on the observed food intake patterns and the nutrient deficiencies, these outcomes propose new diets modifying food intake (organized in food groups) in order to achieve nutritional adequacy while minimizing food intake changes, or, if applicable, the outcomes indicate which nutrient recommendations are unattainable under the current model setup. On average, our results show that nutritional adequacy can be attained by increasing the intake of legumes, vegetables and fruits, while reducing the intake of cereals. We include a discussion on the assessment of diet affordability and show the practical implications of evaluating healthier diets' viability. Conclusions include paths for future research on diet optimization modelling and its implications as a means of support for designing future dietary guidelines.

Keywords: diet optimization; mathematical programming; health and welfare; diet affordability

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New Standards for Nutrition Science, Concepts and Methods—Low Socioeconomic Status and Overweight: Participatory Research Designs for the Development of Interventions [†]

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Keywords: low socioeconomic status; participatory approach; community; overweight; intervention

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Background: The heavy burden of obesity on individuals and society has attracted a lot of attention, and many strategies to prevent or reverse it have been developed. Consequently, many reviews exist on this topic. However, similar to the bulk of studies, most reviews on combatting obesity follow the traditional (bio)medical approach. Dedicated interventions that take the unequal distribution of obesity among socioeconomic groups into account, particularly by applying an interdisciplinary approach that includes participation of the most heavily burdened low-SES groups themselves, are much more scarce and thus also less frequently reviewed. **Objective:** We aim to write a scoping review on interventions or initiatives aiming at obesity among groups with low socioeconomic status that apply a form of participation of the target group. We will focus on community-based programmes. **Methods:** We performed a literature search in Scopus, Web of Science and Pubmed. Using Rayyan software [1], we identified 3227 articles, of which, after screening the abstracts and full texts, 16 were eligible for further extraction of data. **Results:** Currently, we are at the stage of data extraction. Preliminary findings show that participatory approaches have an effect on a range of outcomes in low-SES populations, including dietary patterns, sleep and/or BMI. **Discussion:** By confining the review to community-based participatory research, identifying causal relationships is not our main goal. Nevertheless, we will focus on interventions, initiatives or programmes that aim to generate an impact and therefore go beyond associations or identifications of underlying determinants. Instead, it may give us an understanding of why we tend to be ineffective in combatting obesity in low-SES populations with top-down approaches and possibly identify strategies that do have a long-term impact. At the conference, we will be able to present the final data and conclusions.

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Adherence to French Dietary Guidelines Is Associated with a Reduced Risk of All-Cause, Cardiovascular Diseases and All, Breast and Lung Cancer Mortality in the E3N COHORT [†]

Chloé Marques ^{*} , Pauline Frenoy, Nasser Laouali , Sanam Shah, Gianluca Severi and Francesca Romana Mancini



Belgrade, Serbia, 14–17 November 2023.

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Abstract: Background and objectives: Diet is a modifiable risk factor of non-communicable diseases. The French dietary guidelines, updated in 2017, provide recommendations for a healthier diet. We aimed to study the association between adherence to these dietary guidelines and mortality in the E3N (Etude Epidémiologique auprès de femmes de l'Education Nationale) French cohort. Methods: We studied 72,585 women included in the E3N prospective cohort, which completed a food frequency questionnaire in 1993. Adherence to French dietary guidelines was estimated using the simplified “Programme National Nutrition Santé—guidelines score 2” (sPNNS-GS2, range: −20.4 to 12.6). We estimated the association between sPNNS-GS2 and all-cause or cause-specific mortality using Cox proportional hazard models, adjusted for age (as time-scale), BMI, physical activity, birth generation, education level, smoking status, menopausal status and recent menopausal hormone therapy use, and total energy intake. Results: During follow-up (1993–2014), we identified 6441 deaths. The mean sPNNS-GS2 was 3.8 (SD 3.0). In the fully adjusted model, we found a non-linear inverse association, with a plateau from the third quartile, between sPNNS-GS2 and all-cause (HRQ4 vs. Q1 [95%CI]: 0.79 [0.73; 0.86]), all cancers (HRQ4 vs. Q1 [95%CI]: 0.79 [0.70; 0.89]) and breast cancer (HRQ4 vs. Q1 [95%CI]: 0.73 [0.58; 0.91]) mortality. We also highlighted a non-linear U-shaped association with lung cancer mortality (HRQ3 vs. Q1 [95%CI]: 0.62 [0.45; 0.87] and HRQ4 vs. Q1 [95%CI]: 0.73 [0.52; 1.02]) and a linear inverse association with cardiovascular disease mortality (HRoneSTD [95%CI]: 0.86 [0.76; 0.97]). We observed no association with colorectal cancer mortality (HRoneSTD [95%CI]: 0.86 [0.70; 1.04]). Discussion: This study on a large prospective cohort following more than 70,000 women for over 20 years suggests that a higher adherence to the French dietary guidelines is associated with a reduced risk of mortality from all-cause cardiovascular diseases, all cancers, breast cancer and lung cancer. These results enable us to confirm the French nutritional recommendations. Finally, the reduced risk observed for various mortality outcomes is an important public health message.

Keywords: diet; guidelines; mortality; cohort

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Exploring the Impact of Basal Metabolic Rate Equations on Goldberg Cut-Offs: Influence on Estimated Usual Energy Intake in the Elderly [†]

Živa Lavriša ^{1,2,*}, Igor Pravst ^{1,2,3}  and Hristo Hristov ¹ 



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Keywords: dietary intake misreporting; predictive equations; basal metabolic rate; Goldberg cut-offs

factors, including misreporting, which is one of the major sources of error regardless of the method used. The Goldberg cut-off is commonly used to identify misreporting of DI and includes the ratio of the individuals' reported energy intake (EI) to their estimated basal metabolic rate (BMR), which is then compared to pre-defined cut-offs. BMR can be estimated by applying different equations, considering anthropometric factors or lean body mass (LBM). The literature reports that the use of BMR equations which include LBM are among the most accurate. We aimed to show how applying different BMR equations can affect the parameters in the Goldberg method and further influence the usual EI. The study population was 318 elderly people aged 65–101 years living in different Slovenian nursing homes, who were relatively independent and able to feed themselves, who reported 24 h dietary recall for two non-consecutive days and completed a food frequency questionnaire, and who had an LBM measured with bioelectrical impedance. The usual EI was determined using the Multiple Source Method. A physical activity level (PAL) of 1.2 and 1.5 was applied, based on the expected PAL of participants. A post hoc ANOVA mean difference test using Bonferroni correction showed that differences existed in the mean EI:BMR calculated using different equations. The result of the Harris–Benedict equation, revised by Roza and Shizgal (1984) [1], was significantly different compared to equations which use LBM, while Mifflin et al. (1990) [2] and Porter et al. (2023)'s [3] anthropometric equations showed no significant differences. There were no significant differences between the estimated usual EI calculated based on different equations used in Goldberg cut-offs. The appropriate PAL according to the activity of the study population should be carefully considered, as it might influence the identification of misreporting. Differences were observed in the amount of misreporting between different equations used in the Goldberg cut-off method. Kappa statistics showed that Mifflin et al. (1990)'s [2] equation using anthropometric data had the best agreement with equations that use LBM. We showed that the use of different BMR equations does not impact the estimation of mean usual EI using Goldberg cut-offs; however, it might influence the quartile distribution and subjects' characteristics.

The accurate assessment of usual dietary intake (DI) in the elderly can be difficult, and its reliability can be affected by several

Author Contributions: Ž.L. participated in conducting the study, wrote the abstract and prepared for submission. I.P. participated in conducting the study, reviewing, and editing. H.H. prepared the data, carried out the data analyses, and supported the co-ceptualization and writing the abstract. All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: All participants were fully informed why the research is being conducted and how their data will be used, and consented into study participation, knowing about the ability to withdraw from the study at any time. No risks were identified for study participants. The data presented in this study are available upon request from the corresponding author.

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New Standards for Nutrition Science, Concepts and Methods—Novel Approach to Substantiate Cause- and -Effect Relationships in Nutritional Science by Ranking Studies and Subsequent Statistical Modelling [†]

Wim Calame ^{1,*} , Isabel Slurink ²  and Andrea Budelli ³



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Keywords: cause-and-effect; Bradford Hill criteria; hierarchy of evidence; statistical validation

In any scientific field, demonstrating cause-and-effect relationships is of the utmost importance, however difficult to achieve. The present study aims to establish an objective approach to substantiate cause-and-effect relationships. Our approach consisted of ranking published studies and subsequently using the best performing studies to construct and validate a statistical model. For the first part, studies on the association between vitamin D status and COVID-19 severity (morbidity/mortality) in hospitalized patients were identified and ranked using a combination of physiological and statistical relevance, including dose-dependency, power evaluation, confounding, physiological mechanisms, and target population. The various ranking criteria were developed in an iterative process, taking into account the Bradford Hill criteria. For the second part, a two-step statistical modelling strategy was implemented. Firstly, a multivariate model was constructed and secondly, this model was validated using data from at least one other independent study with a similar design. The sensitivity (percentage of correctly detected cases by the model) and specificity (percentage of correctly detected non-cases by the model) was assessed in both studies, and the results of both studies (model-making and model-testing) were compared using the Chi-square test with expectation. Five ranking criteria were defined with a maximum score of 67 points. Six studies were selected with scores ranging between 27 and 47 points [1–6]. The highest score was obtained by Hernandez et al., 2021 [1]. Unfortunately, it was not possible to obtain complete independent datasets of these studies. Therefore, to evaluate our approach in cause- and -effect relationships, two datasets were selected of studies on the effects of postbiotic intake on the incidence of pulmonary and gastrointestinal infections in children aged 1 to 4 years [7,8]. A logistic confounding model in combination with a discriminant analysis was applied on the first (model-making) study resulting in an internal sensitivity and specificity of 78% and 100%, respectively ($p < 0.001$), showing a treatment effect on the reduction of infections ($p < 0.001$). An external validation of the acquired model in a second independent (model-testing) study showed sensitivity and specificity of 76% and 80% ($p < 0.001$), again showing a treatment effect ($p < 0.001$). The sensitivity and specificity were not statistically different indicating similarity of the impact by the explanatory variables in both datasets. Overall, the combination of ranking studies and statistical modelling supports the validation of cause-and-effect relationships using

objective criteria. Demonstrating consistency in associations by replication and robustness testing contributes to proof of concept in causative relations.

Author Contributions: Conceptualization, W.C. and I.S.; methodology, W.C. and I.S.; formal analysis, W.C. and I.S.; resources, A.B. and W.C.; writing—original draft preparation, W.C. and I.S.; writing—review and editing, all authors. All authors have read and agreed to the published version of the manuscript.

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Philosophical Reflection on Holism and Reductionism in Nutrition Science [†]

Eline Baltussen ^{1,*} and Marcel Verweij ²



Citation: Baltussen, E.; Verweij, M. Philosophical Reflection on Holism and Reductionism in Nutrition Science.

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Abstract: Nutrition, as a science, is facing challenges. While issues regarding obesity, chronic diseases, and sustainability are becoming more pressing, nutrition science is encountering limitations regarding novel insights, trust, and social relevance. In order to move forward, we need to innovate the field and explore new perspectives. Current nutrition research has mainly employed a reductionist approach, which has been very successful in the past. However, reductionism shows limitations when addressing the problems we face today. The addressed weaknesses of reductionism include (1) the questionable assumption that nutrients and calories are exchangeable between foods, (2) the tendency of reductionism to oversimplify reality, which has consequences for complex concepts such as health and nutrition, and (3) the focus on details, which could undermine the aim of nutrition science: creating optimal dietary guidelines for the promotion of health and prevention of disease. Holism offers an alternative perspective that could complement these limitations, on the condition that they are similar enough on an ontological and epistemological level. Holistic approaches to health appear in eastern philosophies (ayurveda), but also in modern western nutrition approaches (dietary patterns). These two holistic approaches can complement reductionism in the following ways: (1) Holistic approaches like ayurveda and dietary patterns provide different nutritional knowledge by considering multiple factors that affect food's health potential, in addition to only nutrients and calories. Some of these factors include food processing, food matrix/structure, food combinations, food compatibility, and nutrient interaction. (2) Holism can complement the reductionistic tendency to oversimplify reality by including subjective, individual, and holistic aspects of health into nutrition research and embracing the complexity of food-chronic disease relationships. (3) Holism has the potential to improve the practical relevance and comprehensibility of nutrition science. All presented results were based on the existing literature, found in Scopus and PubMed. To conclude, this study explores how holism can complement the limitations of reductionism, and as a result, reduce the overemphasis on reductionism as a research approach, which will hopefully promote progress and inspire the future of nutrition science.

Keywords: nutrition; nutrition science; holism; reductionism; ayurveda; dietary patterns

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Development of a Diet Quality Score and Adherence to the Swiss Dietary Recommendations for Vegans[†]

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Abstract: Background: Vegan diets have recently gained popularity in Switzerland and abroad. A method to evaluate the diet quality of the vegan population for research and clinical practice is currently not available. Therefore, the aim of the present study was to develop a diet quality score for vegans (DQS-V) based on the Swiss dietary recommendations for vegans. Methods: The dataset included 52 healthy vegan adults. Dietary intake data were assessed using three-day weighed food records. Body weight and height were measured, and a venous blood sample for the analysis of vitamin and mineral status was collected. Spearman rank correlation coefficients were used due to the presence of not-normally distributed data. Dietary patterns were identified using principal component analysis (PCA). Results: The DQS-V score (mean ± SD) was 48.9 ± 14.7. Most vegans adhered to the recommended portions of vegetables, vitamin C-rich vegetables, fruits, omega 3-rich nuts, fats and oils, and iodised salt. However, the intake of green leafy vegetables, vitamin C-rich fruits, wholegrains, legumes, nuts and seeds, selenium-rich nuts, zero caloric liquid, and calcium-fortified foods was suboptimal. The intake of sweet-, salty-, fried foods and alcohol was higher than recommended. The DQS-V had a significantly positive correlation with intakes of fibre, polyunsaturated fatty acids, potassium, zinc, and phosphorus (p 's < 0.05) but was negatively correlated with vitamin B12 and niacin intakes (p 's < 0.05). Two dietary patterns were derived from PCA: (1) refined grains and sweets and (2) wholegrains and nuts. The correlation between the DQS-V and the first dietary pattern was negative (-0.41 , $p = 0.004$), but positive for the second dietary pattern (0.37 , $p = 0.01$). The dietary pattern of refined grains and sweets was inversely correlated with the beta-carotene status (-0.41 , $p = 0.004$) and the vitamin C status ($r = -0.51$, $p = 0.0002$). Conclusion: The newly developed DQS-V, based on the Swiss dietary recommendations for vegans, provides a single score for estimating the diet quality among vegan adults. Further validation studies examining the correlation of DQS-V with an independent dietary assessment method and with the biomarkers of nutritional intake and status are still needed before the general use of the DQS-V score.

Keywords: diet quality score; diet index; dietary patterns; vegan diet; vegan recommendations; vegan dietary guidelines

Author Contributions: Study concept and design: L.H.B., N.B., K.V.D.H. and I.H.-A.; study execution: N.B., L.H.B. and G.T.; data analysis: N.B., L.H.B. and J.H.; first manuscript draft: N.B., J.H. and L.H.B.; funding acquisition: L.H.B. and I.H.-A.; All authors have read and agreed to the published version of the manuscript.

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Assessment of the Effects of Updated Nutri-Score Nutrient Profiling Algorithm Using a Representative Slovenian Food Supply Dataset [†]

Edvina Hafner ^{1,2}  and Igor Pravst ^{1,2,3,*} 



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its alignment with nutritional recommendations. As a result, the Scientific Committee of the NS published two reports in 2022 and 2023, updating the NS algorithm. The aim of our study was to exploit differences between previous (NS2021) and updated (NS2023) algorithm, using foods from Slovenian food supply. Methods: A total of 19,510 branded foods/drinks from the 2020 Slovenian food supply database were profiled using NS2021 and NS2023. We focused on comparing the distribution of each grade and the discriminatory ability between NS2021 and NS2023, while identifying products that were most affected by the NS2023 changes. We also examined changes in alignment with Slovenian nutritional recommendations based on nationally adapted WHO Europe nutrient profile (WHOE). Results: The results show that both NS2021 and NS2023 have good discriminatory ability, with NS2023 being slightly better in 12 sub-categories. Overall, NS2023 was stricter, with E being the most common grade (32%), whereas NS2021 predominantly assigned a grade of D (28%). While the overall proportion of products with grade C remained almost unaffected, there was a notable decrease in “healthier” products graded A or B, from 30% (NS2021) to 23% (NS2023). NS2023 was stricter than NS2021 in almost all main categories, except for beverages and eggs. Alignment with the WHOE profile was moderate ($\kappa = 0.59$) for NS2021 and strong ($\kappa = 0.65$) for NS2023. Alignment was improved especially for edible oils and emulsions, fruits and vegetables, and snack foods. Discussion: NS2023 was shown to be stricter and more aligned with recommendations than NS2021. The updated NS2023 addressed limitations such as better grading of cooking oils (especially olive oil), higher penalisation of high sugar and salt content, lower grading of beverages with non-nutritive sweeteners, and slight modifications for nuts and cheeses. This study gives first insights into how the update of the NS algorithm works on real-life data and can support policymakers in the implementation of harmonised FOPNL in Europe.

Abstract: Background: Front-of-package nutrition labelling (FOPNL) is an important public health tool for promoting healthier food choices. Therefore, the European Commission has committed to proposing harmonised mandatory FOPNL in Europe. A relevant option for this harmonisation is Nutri-Score (NS), which, however, has been subject to some criticism about

Keywords: Nutri-Score; nutrient profiling; front-of-package labelling; food supply; food policy

Author Contributions: Conceptualization, I.P.; data analyses, E.H.; methodology, I.P. and E.H.; formal analyses, E.H.; writing—original draft preparation, E.H.; manuscript writing—review and editing, I.P. All authors have read and agreed to the published version of the manuscript.

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A Cross-Sectional Study on Micronutrient Adequacy and Associated Factors among School-Going Adolescent Girls [†]

Priyanka Pareek *, Aparna Thorat and Chethana Chandrasekar



Citation: Pareek, P.; Thorat, A.; Chandrasekar, C. A Cross-Sectional Study on Micronutrient Adequacy and Associated Factors among School-Going Adolescent Girls.

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Abstract: Background: Micronutrient deficiency is also

referred as hidden hunger, and it increases the global disease burden. Adolescent girls need nutritional care, and their poor dietary intake leads to micronutrient deficiency and poor maternal outcomes. Therefore, there is an urgent need to assess the micronutrient intake among adolescent girls to plan and promote healthy eating behavior and break the malicious cycle of intergenerational malnutrition. Objective: To assess the micronutrient adequacy and associated factors among school-going adolescent girls. Methodology: A school-based, cross-sectional study was conducted among 300 adolescent girls in the suburban area of Navi Mumbai, Maharashtra, India. A simple random-sampling technique was used to select the study participants. A structured questionnaire was used to assess sociodemographic profiles and other factors. The heights and weights of the participants were measured through a standardized method, and their BMI was calculated. Their dietary intake was assessed by taking 24-h recall for three consecutive days, including the weekend. Nutrient adequacy was assessed as the amount of nutrients per 1000 kcal of the participants' diet that met the critical nutrient density, and it was compared to the observed nutrient densities of the adolescent girls. The data were analyzed using the SPSS software version 24. Independent t, Pearson's correlation, and chi-squared tests were used to assess the difference and association between micronutrient densities and different variables. Results: For most micronutrients (iron, calcium, zinc, vitamin A, vitamin D, thiamin, riboflavin, niacin, folic acid, vitamin B12, and vitamin C) the observed density was less than that recommended, meaning intake was inadequate.

The mean densities of vitamin A, vitamin B12, iron, calcium, and potassium were significantly ($p < 0.05$) associated with age, BMI, dietary diversity scores, socioeconomic status, and body image concern. Conclusion: The findings of this study revealed that micronutrient intake inadequacy among adolescent girls is a public health problem in the study area. Therefore, interventions should be planned with a focus on nutrition-sensitive activities to increase diet diversification and nutrition security among adolescent girls.

Keywords: micronutrient adequacy; adolescents girls; nutrient density

Author Contributions: Conceptualization, P.P.; methodology, P.P.; validation, P.P.; formal analysis, P.P.; investigation, P.P., A.T. and C.C.; resources, P.P. and A.T.; data curation, P.P.; writing—original draft preparation, P.P., A.T. and C.C.; writing—review and editing, P.P.; visualization, P.P., A.T. and C.C.; supervision, P.P.; project administration, P.P. All authors have read and agreed to the published version of the manuscript.

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Defining Public Health Nutrition Goals Based on Food Balance Sheets—A Proof-of-Principle [†]

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[†] Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Background and objectives: Food balance sheets (FBSs) provide comprehensive annual information on a country's food supply, reflecting possible trends in a population's overall food consumption. However, FBSs essentially refer to agricultural products and primary commodities, rather than foods ready to be consumed. Therefore, FBSs have only limited value for assessing the nutritional adequacy of a country's food supply. However, certain data transformations could substantially enhance the suitability of FBSs for public health purposes, considering human and planetary health alike. Methods: Schwinglhackl et al. (2019) [1] estimated disability-adjusted life years (DALYs) attributable to the intake of food groups as well as respective theoretical minimum risk exposure levels (TMREs). These data are translated into respective food supply using ratios of FBS data and respective nationally representative food consumption. Poore and Nemecek (2018) [2] provide data on the environmental impact of 43 agricultural products along the complete supply chain, allowing the analysis of various sustainability parameters for specific products or the entire food supply. Results: The inadequate consumption of nuts or fruits has the highest contribution to food-related DALYs (approx. 20% each), followed by fish and soft drinks (approx. 15% each), and legumes, vegetables, meat, or dairy (approx. 8% each). The average consumption of red meat exceeded the respective TMREL by a factor of 2.6, whereas the consumption of most other food products reached the TMREL only by fraction, e.g., fish and legumes: 20%, respectively, nuts: 26%, and vegetables: 49%. Animal products make up more than 75% of the greenhouse gas emissions attributable to the food sector (red meat: 28%, dairy: 30%, butter: 10%, poultry, fish, and eggs together: 8%). The situation is quite similar when considering freshwater use. Discussion: Despite serious methodological limitations of FBS data, they can provide a valuable basis for defining public health nutrition goals. Clearly, human and planetary health would both benefit from a drastic reduction in meat consumption and a sincere endeavor to replace animal products with plants. **Keywords:** food balance sheets; food supply; DALYs; sustainability; public health nutrition



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Introduction of the European Regulatory Framework for New Sweeteners and Sweetness Enhancers and Its Role as a Facilitator or Barrier to Innovation: Results from the SWEET Project [†]

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Abstract: There is a growing consumer interest and public health mandate to reduce sugar intake, and an increased impetus to innovate in the food sector to develop new and more acceptable sweeteners and sweetness enhancers (S&SEs) as low- or non-caloric replacements for sugar. Within the European context, S&SEs are subject to stringent risk assessment and regulatory framework to permit new S&SEs in the European market. There has been a long-standing debate about the role of regulation in facilitating or slowing down innovation processes. The aim of this study is to examine the S&SE regulation and risk governance framework, with a specific focus on the implementation of the precautionary principle to assess its perceived impact on the food industry's ability to innovate. We conducted six semi-structured interviews with food industry applicants for new and novel S&SE approval. The study results indicate that the legislation is achieving its primary aims of harmonising the approval process, ensuring consumer safety, and contributing to the public health policies of the EU. However, there are several barriers to innovation associated with the regulatory framework, including the application of the precautionary principle and the burden-of-proof requirement facing the industry. The barriers are particularly relevant to small and medium organisations who have limited resources to accommodate these uncertainties. An open dialogue between business operatives and risk assessors would be an important step towards raising this awareness and addressing the uncertainties within the process.

Keywords: non-nutritive sweeteners; sugar-reduction; regulation



Citation: Timotijevic, L.; Hodgkins, C.E.; Raats, M.M.; Raben, A.; Halford, J.C.G.; Harold, J. Introduction of the European Regulatory Framework for New Sweeteners and Sweetness Enhancers and Its Role as a Facilitator or Barrier to Innovation: Results from the SWEET Project. *Proceedings* **2023**, *91*, 111. <https://doi.org/10.3390/proceedings2023091111>

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Effects of Plant-Origin Superoxide Dismutase Supplementation on Selected Parameters of Inflammation and White Blood Cell Count in Athletes [†]

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Abstract: Background and objectives: Regular moderate exercise is considered a protector against chronic inflammatory diseases. Intense exercise causes a significant release of pro-inflammatory cytokines and free radicals depending on exercise intensity and duration. The aim of this study was to investigate the effects of antioxidant supplementation on parameters of immunity and inflammation in athletes. Methods: The study included 14 elite rowers (group 1) and 10 recreational athletes (group 2). All participants were supplemented with 500 mg/day (500 IU SOD) plant-origin superoxide dismutase (GliSODin[®]) during a 6-week pre-competition microcycle preparation period (rowers, 120 min training/6 days weekly; recreational athletes, 60 minutes training/3 days weekly). Venous blood samples were taken in the morning after a 24-hour resting period. White blood cell (WBC) and its subpopulation count were determined using an ACT Diff Hematology Analyzer (Beckman Coulter, Inc., Brea, CA, USA) and CRP concentration using the biochemistry analyzer Olympus

AU400 (Beckman Coulter, Inc., Brea, CA, USA) at the Faculty of Pharmacy, University of Belgrade. Selected cytokines IL-4, IL-6, IL-8, and IL-10 were measured by hs ELISA kits (R&D Systems). All data were analyzed using nonparametric tests (Mann–Whitney U test, Kruskal–Wallis test). Results: WBCs and their subpopulation were all in the reference range in both groups before and after supplementation, without significant differences within and between groups according to tests considering supplementation. In rowers, IL-6 was significantly higher before and after supplementation ($p < 0.001$, $p < 0.001$ respectively), CRP was higher before supplementation ($p = 0.025$), and IL-10 was higher at initial and final testing ($p = 0.030$, $p = 0.040$ respectively). In the recreational group, IL-8 and IL-4 were higher at both measuring points ($p < 0.001$ and $p < 0.01$ respectively). Observing changes in variables within the groups, there was a significantly decreased level of IL-6 ($p = 0.019$) and increased level of IL-4 ($p = 0.001$) in rowers and a higher IL-4 level in the recreational group ($p = 0.059$) after supplementation. Discussion: The results of this investigation indicate that there are positive effects of Glisodin supplementation on parameters of inflammation (decreased IL-6, increased IL-4), especially in highly trained rowers, who are more prone to exercise-related oxidative stress. More studies including a greater number of participants are necessary to confirm the influence of antioxidant supplementation on immunity and inflammation in athletes.

Keywords: athletes; Glisodin; supplementation; inflammation



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M.D. and I.S.; funding acquisition, I.S. and B.Đ. All authors have read and agreed to the published version of the manuscript.

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Adherence to the Mediterranean Diet and the Consumption of Its Food Groups in a Sample of over 10,000 Italian Adults [†]

Sofia Lotti * , Monica Dinu , Giuditta Pagliai, Marta Tristan Asensi , Antonia Napoletano, Barbara Colombini  and Francesco Sofi



Citation: Lotti, S.; Dinu, M.; Pagliai, G.; Tristan Asensi, M.; Napoletano, A.; Colombini, B.; Sofi, F. Adherence to the Mediterranean Diet and the Consumption of Its Food Groups in a Sample of over 10,000 Italian Adults. *Proceedings* **2023**, *91*, 16. <https://doi.org/10.3390/proceedings2023091016>

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Abstract: Adherence to the Mediterranean diet (MD) has been shown to promote health and reduce the prevalence of several chronic diseases. However, to date, more and more countries in the Mediterranean basin seem to be moving away from their traditional eating habits, including Italy. Therefore, the aim of this study was to investigate adherence to the MD and the consumption of its food groups in a large sample of Italian adults. After the removal of duplicates, the study sample comprised 10,916 questionnaires, of which 7088 were completed by women (65%) and 3828 by men (35%). The dietary intake of each food group component in the questionnaire was estimated by multiplying the frequency by the portion size. The mean Medi-Lite score was 12 ± 2.5 , suggesting a moderate level of MD adherence, with a significantly ($p < 0.05$) higher level of adherence observed in women and older subjects. The analysis of the consumption of the individual food groups showed a consumption behavior in line with the national dietary recommendations of fruit (342 g/day), pasta (96 g/day), white meat (302 g/week) and fish (296 g/week). On the other hand, a low consumption of vegetables (270 g/day), bread (85 g/day), legumes (233 g/week) and milk and dairy products (187 g/day) emerged. In addition, the consumption of red meat (209 g/week) was observed to be twice as high as the national guidelines. Subgroup analysis showed that women and the elderly consumed significantly ($p < 0.001$) more fruit, vegetables, and bread and less meat and meat products than did men and younger subjects. Upon a logistic regression analysis adjusted for possible confounding factors, women showed an increased probability (OR 1.34, 95%CI 1.22–1.46; $p < 0.001$) of being in the highest MD adherence tertile (i.e., Medi-Lite score > 11). Although the sample reported moderate adherence to MD, the consumption of some typically Mediterranean food groups such as vegetables, legumes and bread is still low, while the consumption of red meat is high.

Keywords: Mediterranean diet; Medi-Lite; dietary habits; dietary guidelines; food consumption

Author Contributions: Conceptualization: S.L., M.D., F.S.; Analysis and interpretation of the data: S.L., A.N., M.T.A., M.D., F.S.; Drafting of the article: S.L., G.P., B.C., F.S., Critical revision of the article for important intellectual content: A.N., M.T.A., G.P.; Final approval of the article: G.P., B.C., M.D., F.S.; Statistical expertise: M.D. All authors have read and agreed to the published version of the manuscript.

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Weight Loss Effect of an App-Based Multimodal Lifestyle Intervention in Adults with Obesity—A Randomized Controlled Trial †

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Citation: Gemesi, K.; Winkler, S.; Schederecker, F.; Hauner, H.; Holzapfel, C.

Weight Loss Effect of an App-Based Multimodal Lifestyle Intervention in Adults with Obesity—A Randomized Controlled Trial.

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† Presented at the 14th European Nutrition Conference FENS 2023, Belgrade, Serbia, 14–17 November 2023.

Abstract: Quality-proven Digital Health Applications (DiGAs) or “apps on prescription” in Germany extend obesity treatment options. This 24-week single-center randomized controlled trial aimed to examine the weight-lowering effect of an evidence-based multimodal weight loss intervention program delivered by a DiGA. **Methods:** Adults with a body mass index (BMI) between 30.0 and 40.0 kg/m² were randomized. In the first 12 weeks, participants either received the app (ADHOC group) or were asked to maintain their current lifestyle (EXPECT group). In the second 12 weeks, the ADHOC group were invited to continue app use and the EXPECT group started with the app intervention. At three visits (baseline, after 12, and 24 weeks), anthropometric variables were measured and quality of life, app usage, and user acceptance were collected by questionnaires (Euroqol, Technology Acceptance Model 3, System Usability Scale). A total of 168 participants (age: 46.8 ± 11.0 years, BMI: 34.2 ± 2.8 kg/m², 64.3% women) were included. The total adherence rates were 82.7% after 12 weeks and 67.3% after 24 weeks. After 12 weeks, the ADHOC group showed a mean weight loss of 3.2 ± 3.0% and the EXPECT group a mean weight loss of 0.3 ± 2.6% with a statistically significant difference between the groups ($p < 0.001$, completers analysis). At the 12-week follow-up, the ADHOC group maintained body weight (weight loss after 24 weeks: 3.1 ± 4.5%, completers analysis), whereas the EXPECT group—starting with the app intervention—lost weight. The investigated multimodal intervention program delivered by a DiGA resulted in a significant and clinically meaningful short-term weight loss with weight maintenance for a further three months.

Keywords: digital; e-Health; weight management

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Author Contributions: Study protocol design, C.H. and H.H.; conducting study visits, K.G., S.W., and C.H.; data management and statistical analysis, K.G.; support of statistical analysis, F.S.; data interpretation, K.G., F.S., H.H. and C.H.; writing, K.G. All authors contributed to the manuscript and approved the submitted version. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethical Committee of the School of Medicine and Health at the Technical University of Munich (number: 45/22 S-NP, date: 3 March 2022). The study protocol has been submitted to BfArM (Federal Institute for Drugs and Medical Devices) for reviewing before

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starting the trial. The study is registered in the German Register of Clinical Studies (Registration number: DRKS00025291).

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Nutritional and Anthropometric Status of Serbian Adults 10–74 Years Old: Results from European Food Safety Authority (EFSA) EU Menu Food Consumption Survey 2017–2021 [†]

Jelena Milešević ^{*} , Milica Zekovic ^{*} , Ivana Šarac , Marija Knez, Marija Takic ^{*}, Jasmina Debeljak and Mirjana Gurinovic ^{*}

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Abstract: The Serbian National Food Consumption Survey on adults from 10 to 74 years old, including pregnant women and vegetarians, was conducted in compliance with the EFSA EU Menu project support and guidance from 2017 to 2022. Valid data were collected from a total of 3018 participants with 856 adolescents aged 10 to 17 years, 1155 adults aged 18 to 64, 581 elderly subjects aged 65 to 74 years, 145 pregnant women, and 281 persons following a vegetarian diet. Data collection was conducted using a national Survey Pack designed for the project, including the following: a general questionnaire, an age-appropriate Food Propensity Questionnaire, an International Physical Activity Questionnaire, and 24 h dietary recall. The advanced nutritional platform Diet Assess and Plan (DAP) was applied for data storage, processing, and the creation of the final dataset for transfer to EFSA. The Serbian food composition database was used and updated during the project as a resource of food information for all foods and recipes that were consumed by the study cohort. Regardless of age and gender category, the majority (56%) of adults had normal weight according to the Body Mass Index, while 21% were overweight, and 15.5% were underweight. The average daily energy intake was 2178.72 kcal, while overall contributions of carbohydrates, protein, and fat to the total energy intake were 43.37%, 15.47%, and 41.16%, respectively. The proportions of macronutrient intake deviated from the dietary reference values, particularly for fat, which was often too high, where sunflower oil was the major source of fat in diets. Out of the 3018 participants, 98% had breakfast, 99% had lunch, and 95% had dinner, while approx. 80% had snacks between main meals. The highest energy intake was recorded during lunch, 706.5 kcal (32% TE). The survey results provide valuable insight into the nutritional status and dietary habits of adults from 10 to 74 years old living in Serbia. The Serbian food consumption database serves as an evidence platform for decision-making processes in public health nutrition policies and strategies, diet monitoring, exposure risk assessments, and interventions targeting identified nutritional challenges in particular population groups. Harmonized data are part of the EFSA comprehensive food consumption database.

Keywords: food consumption; dietary assessment; nutritional status; body mass index; EFSA EU Menu



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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Results attained in this study are included in the manuscript. Individual data are not available due to official legal, organizational and data security policies, and ethical restrictions.

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Multi-Faceted Nutritional Science Demonstrated through the Prism of Sugar—A Scoping Review on Sugar Intake Associated with Quality of Life in Children and Adolescents [†]

Stefania Noerman ^{1,*} , Ute Nöthlings ² , Danijela Ristic-Medic ³, Bryndís Eva Birgisdóttir ⁴ , Inge Tetens ⁵  and Marjukka Kolehmainen ⁶ 



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Abstract: Given our current knowledge and insights into the nature of nutrition, a simplistic approach to understanding the role of nutrition in relation to health outcomes appears insufficient as a scientific base for setting nutrition policies. To raise this issue, we performed a scoping review to evaluate the relationship between sugar intake, quality of life (QoL), and well-being in children and adolescents. Sugar was selected as it is an essential part of many different foods and dietary patterns. Its consumption is motivated by various aspects, such as social relationships, economic status, individual habits, and taste preferences. Childhood and adolescence are important periods in the life span influencing individual dietary habits and taste preferences but have been overlooked. We developed a framework and performed a structured literature search for articles published in English between 2001 and 2023 in three databases (Pubmed, Scopus, and Web of Science). This search resulted in 21 full-text eligible papers with highly heterogeneous exposure and outcome measures. Most studies found a negative association between the intake of sugar, sugar-sweetened beverages, or sweets, and various QoL outcomes, including food insecurity, sleep and sleep-related outcomes, and (oral) health-related QoL. This scoping review showed that the inclusion of more varied endpoints than only non-communicable diseases or caries could add more dimensions to the evidence underlying the association between sugar and health. The application of interdisciplinary approaches considering more aspects of sugar intake could give a more holistic view of nutrition when considering dietary recommendations or developing dietary policies, especially for children.

Keywords: nutrition; methodology; quality of life; dietary guidelines; well-being

Author Contributions: Conceptualization and methodology, all authors; literature search, title screening, S.N.; abstract and full-text screening, U.N., D.R.-M., B.E.B., I.T. and M.K.; writing—original draft preparation and visualization, S.N.; writing—review and editing, U.N., D.R.-M., B.E.B., I.T. and M.K. All authors have read and agreed to the published version of the manuscript.

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Changes in Eating Habits and Contributing Factors during the COVID-19 Pandemic among Medical Students in the Slovak Republic [†]

Jana Babjakova ^{1,*} , Katarina Mayer Vargova ¹, Sona Wimmerova ² and Lubica Argalasova ¹ 



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Abstract: Due to the outbreak of the new coronavirus disease, many lifestyle alterations occurred. Changes in eating habits and contributing factors during the COVID-19 pandemic were examined.

A cross-sectional anonymous online survey was conducted among students from the Faculty of Medicine, Comenius University in Bratislava, during November–December 2022. The data were statistically analysed using IBM SPSS Statistics, version 25. The study population consisted of 783 students; the mean age was 22.7 ± 2.7 years; 68.1% studied in the Slovak language; 67.0% of respondents were female. Out of these, eating habits did not change for the majority of students in the study sample (53.1%) (Slovaks 52.6% vs. foreigners 54.0%; males 53.0% vs. females 53.1%); consumption of alcoholic beverages did not change compared to pre-pandemic period for 54.3% of students, the rest of students decreased (30.6%) or increased (15.1%) consumption; energy drinks consumption remained unchanged for 69.6% students; coffee intake stayed stable for 48.3%, whereas 43.8% increased their coffee consumption, while 7.8% drank less coffee, without any statistically significant difference between the subgroups. The level of physical activity (frequency, intensity, duration) changed with a significant difference between Slovak and foreign students ($p = 0.038$), more foreign students decreased their level of physical activity compared to Slovaks (42.3% vs. 33.8%). We also recorded body weight changing during the pandemic, with a statistically significant difference between men and women ($p = 0.009$); 14.3% of men vs. 22.9% women decreased, while 34.7% of men and 27.3% of women increased their body weight. The results showed some changes in the dietary habits and other lifestyle factors during the pandemic among medical students. Future healthcare providers will play key roles in health promotion and disease prevention, and they should serve as role models for their patients and the general public as well.

Keywords: medical students; COVID-19; changes; dietary habits

Author Contributions: Conceptualization, J.B. and L.A.; methodology, J.B.; software, S.W.; validation, J.B., L.A. and S.W.; formal analysis, S.W.; investigation, J.B.; resources, K.M.V.; data curation, S.W.; writing—original draft preparation, J.B.; writing—review and editing, L.A. and S.W.; visualization, K.M.V.; supervision, L.A.; project administration, J.B. All authors have read and agreed to the published version of the manuscript.

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Capacity Development and Harmonization of Food Consumption Data Collection in EFSA EU Menu National Dietary Surveys in Balkan Region-Building: The Evidence Base for Diet Monitoring and Food Systems Transformation [†]

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Abstract: Harmonized and standardized collection, processing, and analysis of individual dietary data is essential for nutrition assessment and informed policy decision making. To underpin the harmonization of food consumption data collection methodologies and the development of a common, comprehensive European food consumption database, the European Food Safety Authority (EFSA) supported 36 child and/or adult dietary surveys in 18 EU Member States and four Balkan preaccession countries through the EU Menu Project. Given the lack of relevant and harmonized research and data on food and nutrition in the Balkan region, CENM-IMR and CAPNUTRA scientists focused their activities on capacity building in nutrition research, particularly on the creation of a contemporary, harmonized research infrastructure (RI) that meets European standards. The EFSA EU Menu methodology has been implemented in the Balkans through the adaptation and use of an innovative, comprehensive tool for the standardized collection of food consumption and dietary intake assessment data, the Diet Assess and Plan (DAP). DAP has the essential features of an RI needed to strengthen public health surveillance, monitoring, evaluation, and nutrition research; this is a unique example of a standardized and harmonized tool for assessing dietary intake, i.e., collecting data on food and nutrition in the Balkan region and beyond. It is a concurrent tool for large-scale nutritional epidemiological studies and represents one of the new technologies for dietary intake assessment. National dietary surveys were conducted from 2017 to 2023 among adults aged 10 to 74 years (in Bosnia and Herzegovina, Montenegro, and Serbia) and children aged three months to nine years (in Montenegro, North Macedonia, and Serbia). The collected data on food consumption are internationally comparable with other European countries under the EU Menu Program. The data collected will be used for dietary and exposure risk assessment, establishment of national nutrient reference values, as a basis for the development of food-based dietary guidelines, a tool to provide evidence and infrastructure for public health nutrition policy decisions, and for tailored pathways to transform the food system in the Balkans towards a more nutrition-sensitive and sustainable system.

Keywords: capacity development; food consumption; EU Menu; harmonization



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Is Thinness Associated with Poorer Diet and Nutrient Intake and Status in Danish 8–11-Year-Olds? [†]

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Abstract: Thinness is used to denote low BMI in children and may be a marker of undernutrition. However, despite prevalence rates of up to 10%, thinness in children is highly overlooked in high-income countries, and we have little knowledge about the diet and nutrient status among these children. We investigated if dietary intake and biomarkers of nutrient status, including iron, *n*-3 LCPUFA and vitamin D, differed in Danish schoolchildren with thinness compared to children with normal and overweight. We also investigated if intakes of important micronutrients were adequate across weight groups. We used cross-sectional data from 815 Danish 8–11-year-old children collected during the period August–November 2011. Measurements included 7-day dietary records, anthropometry and analysis of nutritional biomarkers in fasting blood samples. We defined thinness using the age- and sex-specific IOTF BMI cut-offs. In total, 10.2% of the children had thinness (boys: 8.9%; girls: 11.6%). These children had lower intake of energy, protein and red meat and higher intake of added sugar compared to children with normal and overweight. Thinness was also associated with higher fish intake compared to overweight, but we found no group differences in whole-blood EPA+DHA. Furthermore, thinness was associated with lower intake of iron and zinc than the other groups and lower intake of selenium versus normal weight, but with no group differences in iron biomarkers, serum ferritin or hemoglobin. The proportions of children with adequate intake of zinc and selenium were lower in the thin (56.5% and 50.7%) compared to the normal-weight children (72.5% and 63.9%) ($p < 0.05$), but the intake of these micronutrients as well as vitamin B12 and calcium were generally high across all weight groups. In contrast, intake of vitamin D and iron were low across groups, and there were no group differences in serum 25(OH)D. Danish children with thinness had different dietary intake than children with normal and overweight, but thin children did not generally have a poorer diet than normal-weight children. We also found comparable nutrient status and intakes of important micronutrients except for iron, zinc and selenium, which were lower in thin children and should be explored further.

Keywords: thinness; underweight; dietary intake; nutrient status

Author Contributions: The authors' responsibilities were as follows—C.T.D., K.S.-L. and A.V.A. designed the research; C.T.D., L.L. and A.B.-J., R.A. conducted the OPUS study; A.V.A. performed the statistical analyses; A.V.A. wrote the drafts of the paper with help from C.T.D. and K.S.-L.; A.B.-J. developed, validated and prepared the dietary assessment method; A.V.A. has primary responsibility for the final content. All authors have read and agreed to the published version of the manuscript.

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Informed Consent Statement: Written informed consent was obtained from the custody holders of all children.

Data Availability Statement: Data described in this abstract will not be made available because data are not anonymized and due to the Danish legislation therefore considered as “personal data”.

Conflicts of Interest: The authors declare no conflict of interest.

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Editorial

Preface and Statement of Peer Review

Philip C. Calder and Sladjana Sobajic



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Preface and Statement of Peer Review

Philip C. Calder ^{1,2,*} and Sladjana Sobajic ^{3,*} 



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conference was organized by the Federation of European Nutrition Societies (FENS) and local organizer the Serbian Nutrition Society.

The theme of the 14th European Nutrition Conference is “Food, Nutrition and Health: Translating Science into Practice”. Around this theme, the conference will deliver a high quality programme, featuring international speakers across plenary sessions and scientific symposia. Other features of the programme will be workshops, training sessions, industry symposia, and oral and poster sessions oriented towards early career researchers. This conference will provide opportunities to hear experts and to catch up on the latest science, as well as to become better informed about areas of controversy. The topics of the planned conference symposia are broad and multidisciplinary and will appeal to all those interested in experimental, clinical, and public health nutrition.

2. Conference Committees

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1. Conference Overview

This publication collates the proceedings of the 14th European Nutrition Conference, held from 14 to 17 November 2023 in Belgrade, Serbia. The

- Bryndís Eva Birgisdóttir, University of Iceland, Reykjavik, Iceland
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- Stefan Lorkowski, Friedrich Schiller University Jena, Jena, Germany
- Armando Perez Cueto, Umeå University, Umeå, Sweden
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- Ristic Medic Danijela, Institute for Medical Research, Belgrade, Serbia
- Stojanovic Dusica, University of Nis, Nis, Serbia
- Vasiljevic Nadja, University of Belgrade, Belgrade, Serbia
- Zilic Sladjana, Maize Research Institute, Zemun Polje, Serbia

	Symposium Sessions	Oral Sessions	Poster Sessions
Nutrition across the life course	10	5	4
Nutrition, metabolism, and chronic disease	14	8	8
Dietary studies, guidelines, and recommendations	6	5	3
New technologies in nutrition research	4	1	1
Personalised nutrition	4	1	2
Nutrition and the environment, sustainability, and biodiversity	5	4	3
Food science	4	2	3
Dietary bioactives	4	2	2
Nutrition education, consumers, and practitioners	5	1	2
Cultural, societal, and behavioural aspects of diet and nutrition	4	2	3

3. Conference Topics and Number of Sessions for Each Topic

4. Statement of Peer Review

In submitting conference proceedings to *Proceedings*, the volume editors of the proceedings certify to the publisher that all papers published in this volume have been subjected to peer review overseen by the volume editors. Reviews were conducted by expert referees to the professional and scientific standards expected of a proceedings journal.

- Type of peer review: single-blind
- Conference submission management system: infozonet.in.rs
- Number of submissions sent for review: 741
- Number of submissions accepted: 682
- Acceptance rate (number of submissions accepted/number of submissions received): 0.92
- Average number of reviews per paper: 1
- Total number of reviewers involved: 38
- Description of the process of peer review and/or editorial oversight of all accepted content (e.g., detailed criteria or policy of peer review, etc.): All

participants received the result of the review. The types of decisions were as follows: Accept, Resubmit after revision, and Reject.

Conflicts of Interest: The authors declare no conflict of interest. No significant competing financial, professional, or personal interests may influence the performance or the presentations of the works described in this conference. Peer reviewers have no relevant financial or other relationships to disclose.

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