Nutrition Briefs

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Dietary Patterns

Diet Quality Trajectories From Infancy to Young Adulthood: The Special Turku Coronary Risk Factor Intervention Project (STRIP) Study

Saija Tarro, Jussi Vahtera, Jaana Pentti, Harri Niinikoski, Olli Raitakari, Tapani Rönnemaa, Jorma Viikari, Katja Pahkala, et. al.

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Background: Stability in dietary habits has been observed during childhood and adolescence, but their stability from infancy to adulthood is less known. **Objectives:** Our aim was to identify latent diet quality trajectories from age 1 to 18 y and to examine their association with diet quality at age 26 y. **Methods:** The study included 620 participants from the Special Turku Coronary Risk Factor Intervention Project, initiated in infancy. Food and nutrient intake were assessed annually from age 1 to 18 y and again at age 26 y using food records. A food-based diet score (range: 0–33) was calculated to indicate diet quality. Group-based modeling was used to model trajectories of diet quality between the ages of 1 and 18 y. Logistic regression analysis examined associations of childhood sociodemographic characteristics with diet trajectories. Linear regression analyses investigated associations between the observed developmental diet quality trajectory groups and diet quality at age 26 y, adjusted for adulthood sociodemographic characteristics. **Results:** From age 1 to 18 y, 5 diet quality trajectory groups were identified: low (19% of participants), decreasing (25%), increasing (15%), intermediate (31%), and high (10%). Throughout the follow-up period, the diet score remained at 20–22 in the high diet quality trajectory group and at 11–13 in the low diet quality trajectory group. The diet quality trajectory groups predicted diet quality at age 26 y ($P < 0.001$). The adjusted mean difference in adulthood diet score between the low and high diet trajectory groups was 3.6 (95% CI: 1.5, 5.7). Notably, participants in the intervention group had higher scores than controls across all trajectories and throughout the entire follow-up period. **Conclusions:** The 5 distinct diet quality trajectory groups from infancy to adulthood highlight a clear difference between the highest and lowest diet quality groups. The findings suggest that dietary habits established in early childhood remain moderately stable into early adulthood.

Carbohydrates

Induction of Fructose Mediated *De Novo* Lipogenesis Coexists with the Upregulation of Mitochondrial Oxidative Function in Mice Livers

Parama Bhattacharjee, Ayeesha Fadlaoui, Caitlin E Ryan, Courtney B Carlson, Daoning Zhang, Nishanth E Sunny.

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Background: Dysfunctional mitochondrial metabolism and sustained de novo lipogenesis (DNL) are characteristics of metabolic dysfunction-associated steatotic liver disease (MASLD), a comorbidity of obesity and type 2 diabetes. Fructose, a common sweetener and a potent inducer of lipogenesis, contributes to the etiology of MASLD. **Objectives:** Our goal was to determine whether higher rates of DNL, through its biochemical relationships with mitochondria, can contribute to dysfunctional induction of oxidative networks in the liver. **Methods:** Male C57BL/6JN mice were given a low-fat (10% fat kcal, 49.9% corn starch kcal), high-fat (HF; 60% fat kcal), or HF/high-fructose diet (HF/HFr; 25% fat kcal, 34.9% fructose kcal) for 24 wk. In a follow-up study, mice on normal feed pellets were provided either 30% fructose in drinking water (FW) to induce hepatic DNL or regular water (NW) for 14 d. Hepatic mitochondria and liver tissue were used to determine oxygen consumption, reactive oxygen species (ROS) generation, tricarboxylic acid (TCA) cycle activity, and gene/protein expression profiles. **Results:** Hepatic steatosis remained similar between HF and HF/HFr fed mice livers. However, lipogenic and lipid oxidation gene expression profiles and the induction of TCA cycle metabolism were all higher ($P \leq 0.05$) in HF/HFr livers. Under fed conditions, the upregulation of DNL in FW livers occurred in concert with higher mitochondrial oxygen consumption (basal; 1.7 ± 0.21 compared with 3.3 ± 0.14 nmoles/min, $P \leq 0.05$), higher ROS (0.87 ± 0.09 compared with 1.25 ± 0.12 μM, $P \leq 0.05$) and

740 15th Street NW
Washington, DC
20005

Tel: 202.659.0184, Ext. 135
Fax: 202.659.3859
iafns@iafns.org

higher flux through TCA cycle components P ≤0.05. Furthermore, TCA cycle activity and lipid oxidation remained higher during fasting in the FW livers P ≤ 0.05. **Conclusions:** Our results show that fructose administration to mice led to the concurrent induction of mitochondrial oxidative networks and DNL in the liver. Sustained induction of both DNL and mitochondrial oxidative function could accelerate cellular stress and metabolic dysfunction during MASLD.

Protein

Toward Harmonizing Protein Data in Food Composition Databases

Larissa E. Pferdmenges, Paolo C. Colombani, Monica Hauger Carlsen, Anne-Maria Pajari, Anders Poulsen, M. Graça Dias, et. al. *Crit. Rev. in Food Sci & Nutrit*, 1-14. 6 June 2025. doi.org/10.1080/10408398.2025.2503461. Article link

Protein content in foods has historically been estimated by multiplying measured nitrogen content with a universal nitrogen-to-protein conversion factor (NCF) of 6.25. Despite scientific consensus that this approach leads to systematic overestimations due to variations in amino acid composition and non-protein nitrogen (NPN) content, no universally accepted revision has been implemented. This review critically examines diverse perspectives on protein quantification and their implications for Food Composition Databases (FCDBs). A structured definition of protein for FCDBs is proposed, including amino acid residues, free amino acids and small peptides, while explicitly excluding NPN and prosthetic groups. Furthermore, analytical methods and NCF calculations are evaluated in order to provide more accurate assessments of protein content across a range of food matrices. The review highlights the importance of selecting food-specific NCFs to reduce overestimations, ensuring both scientific accuracy and practical feasibility. By addressing methodological shortcomings and proposing a refined protein quantification framework, this work aims to facilitate the transition toward more precise and harmonized protein values in FCDBs, benefiting nutritional research, dietary guidelines, and food labeling regulations.

Food Classification

Processed Foods in the Context of a Vegan Diet, and Changes in Body Weight and Severe Hot Flashes in Postmenopausal Women: A Secondary Analysis of a Randomized Clinical Trial

Hana Kahleova, Tatiana Znayenko-Miller, Arathi Jayaraman, Giulianna Motoa, Laura Chiavaroli, Richard Holubkov, Neal Barnard. *Menopause,* 29 May 2025. DOI: 10.1097/GME.0000000000002563. Article link

Objectives: A plant-based diet has been shown to reduce hot flashes, partly by weight loss. Because some plant-based foods are highly processed, this secondary analysis assessed associations between consumption of processed foods, body weight, and severe hot flashes in postmenopausal women. **Methods:** Participants (N=84) were randomly assigned to a low-fat vegan diet supplemented with soybeans (n=42) or an omnivorous control group (n=42) for 12 weeks. Three-day diet records were analyzed using the Nutrition Data System for Research software; the NOVA classification was used to assess processed food consumption. A repeated measures ANOVA was used for statistical analyses. Results: Consumption of unprocessed or minimally processed animal foods decreased in the vegan group, compared with the control group; effect size: −106 g/d (95% CI: −169 to −42); P=0.002. The reduction in consumption of unprocessed or minimally processed animal foods was associated with weight loss (r=+0.45; P<0.001) and a reduction in severe hot flashes (r=+0.31; P=0.01). Similarly, consumption of ultra-processed animal foods decreased in the vegan group by 60 g/d (95% CI: −105 to −15); P=0.004, with no significant change in the control group; effect size: −65 g/d (95% CI: −115 to −16); P=0.01. The reduction in consumption of ultra-processed animal foods was associated with weight loss (r=+0.43; P<0.001). Consumption of ultra-processed plant-based foods changed only minimally and nonsignificantly and was not associated with changes in weight or hot flash frequency. Conclusions: These findings suggest that, in the context of a soybean-supplemented vegan diet, replacing the consumption of both unprocessed or minimally processed and ultra-processed animal foods with plant foods (regardless of the level of processing), was associated with significant weight loss and a reduction in severe hot flashes.

Low- and No-Calorie Sweeteners

The Non-Nutritive Sweetener Erythritol Adversely Affects Brain Microvascular Endothelial Cell Function

Auburn R. Berry, Samuel T. Ruzzene, Emily I. Ostrander, Kendra N. Wegerson, Nathalie C. Orozco-Fersiva, Madeleine F. Stone, Whitney B. Valenti, et. al. *Jrnl of Applied Physiology*. 16 June 2025. doi.org/10.1152/japplphysiol.00276.2025. Article link

The experimental aim of this study was to determine, in vitro, the effect of the non-nutritive sweetener erythritol on brain microvascular endothelial cell oxidative stress, nitric oxide (NO) and endothelin (ET)-1 production, as well as tissue-type plasminogen activator (t-PA) release. Human cerebral microvascular endothelial cells (hCMECs) were cultured and treated with 6 mM erythritol, equivalent to a typical amount of erythritol (30 g) in an artificially sweetened beverage, for 3 h. Intracellular reactive oxygen species (ROS) production was significantly higher in hCMECs treated with erythritol (204 ± 32% vs. 105 ± 4%) as well as the expression of antioxidant proteins, superoxide dismutase-1 [332.1 ± 16.2 vs. 214.9 ± 4.7 arbitrary units (AU); P = 0.002] and catalase (30.9 ± 0.3 vs. 24.4 ± 0.9 AU; P = 0.002). Although endothelial nitric oxide synthase (eNOS) expression was not significantly altered (102.8 ± 21.4 vs. 99.0 ± 19.9 AU); the expression of p-eNOS (Ser1177) was lower (52.1 ± 2.1 vs. 77.3 ± 9.1 AU; P < 0.001), and p-eNOS (Thr495) was higher (63.4 ± 8.0 vs. 45.6 ± 6.9 AU; P = 0.006) in hCMECs treated with erythritol. Cell expression of Big ET-1 was also higher in erythritol-treated cells (56.4 ± 9.8 vs. 40.9 ± 6.5 AU; P = 0.02). Consequently, the endothelial NO production was significantly lower (5.8 ± 0.8 vs. 7.3 ± 0.7 µmol/L) and ET-1 production was significantly higher (34.6 ± 2.3 vs. 26.9 ± 1.5 pg/mL) in response to erythritol. t-PA release in response to thrombin was significantly blunted in erythritol-treated (from 87.4 ± 6.3 to 87.6 ± 8.3 pg/mL) versus untreated (90.1 ± 5.5 to 110.2 ± 6.4 pg/mL) hCMECs. In summary, erythritol adversely affects oxidative stress, NO production, ET-1 production, and t-PA release in brain microvascular endothelial cells, potentially contributing to the increased risk of ischemic stroke associated with erythritol.

Cognitive Health

Associations between Diet and Cognitive Function in Stroke Survivors: A Systematic Review and Meta-Analysis

Sasan Amanat, Aimee L Dordevic, Amy Brodtmann, Barbara R Cardoso. *Adv. in Nutrition*, Vol. 16, Issue 6, June 2025. DOI: 10.1016/j.advnut.2025.100440. Article link

Poststroke cognitive decline is a major form of disability in stroke survivors. Although dietary interventions have shown potential in improving cognitive outcomes in stroke-free populations, their effects on stroke survivors remain unclear. This review aimed to evaluate associations between diet and cognitive function in stroke survivors. MEDLINE, Embase, Scopus, and CINHAL were searched for studies from inception to 16 December, 2024. Eligible articles were observational and interventional studies on adult stroke survivors that evaluated the association/effect of any nutritional exposure/intervention on cognitive performance and dementia risk. Studies were excluded when an intervention was combined with nonnutritional treatment. Random-effects meta-analysis was used for similar randomized clinical trials. This review included 20 clinical trials and 14 observational studies assessing the intake of energy and proteins and a variety of single nutrients, as well as dietary patterns, single foods, and phytochemicals. Meta-analyses revealed a positive effect of energy-protein supplementation on global cognition [standardized mean difference (SMD): 0.62; 95% confidence interval (CI): 0.15, 1.08; P = 0.009], and a negative effect of B-vitamins (folic acid, vitamin B6, and vitamin B12) (SMD: −0.40; 95% CI: −0.72, −0.08; P = 0.02). Adherence to the Mediterranean-Dietary Approaches to Stop Hypertension (DASH) Intervention for Neurodegenerative Delay and plant-based diets, as well as higher consumption of fruits, milk, coffee, vitamin E, and selenium, were related to better cognitive outcomes; no significant association was observed for adherence to DASH and Mediterranean diets and consumption of vitamins D and C. Butter and sugar intake and calcium supplementation were associated with negative cognitive outcomes. Mixed results were seen for omega (ω)-3, tea, and plant extracts. The available evidence indicates that energy-protein supplementation may benefit cognition after stroke, whereas B-vitamin supplementation has no effect. The substantial heterogeneity among studies hinders conclusions about other dietary strategies.

Lipids

Causal Relationship Between Diet, Lipids, Immune Cells, and Chronic Fatigue Syndrome: A Two-Mediation Mendelian Randomization Study

Jixu Li, Qi Qin, Yiran Zhu, Yulu Qian, Jialu Yin, Xin Gao, Huijuan Wen, et. al. *Food Sci & Nutrit.* 22 June 2025. doi.org/10.1002/fsn3.70424. Article link

Chronic fatigue syndrome (CFS) is a disorder characterized by severe unexplained fatigue and is associated with various factors including infections, immune responses, genetics, and environmental influences. However, the underlying mechanisms and possible interventions for CFS remain unclear. We used a two-mediated MR method to investigate causal relationships between diet, lipid levels, immune cells, and CFS. Our findings suggest that certain lipids, specifically low-density cholesterol, apolipoprotein E, and apolipoprotein B, contribute to CFS development. Conversely, high-density lipoprotein cholesterol and apolipoprotein A1 may delay the onset of the syndrome. Additionally, we explored how lipids affect fatigue through immune cell mediation. Factors, such as hematopoietic stem cell absolute count, the percentage of CD3-natural killer lymphocytes, and IgD presence on IgD+ CD38+ B cells may mediate the causal pathway linking lipids to CFS. Furthermore, we examined the relationship between diet, lipids, and CFS. This indicated that specific dietary selections, like alcohol intake, a preference for chili peppers, and an affinity for breakfast, contributed to CFS. Conversely, cheese and pork consumption were protective factors against CFS. The protective effect of cheese consumption on CFS was mediated by apolipoprotein A1 and high-density lipoprotein cholesterol. In conclusion, the study established an ecological chain: cheese consumption leads to increased high-density lipoprotein cholesterol and alters immune cell phenotypes—specifically, increasing the percentage of CD3-lymphocytes and IgD on IgD+ CD38+ B cells—ultimately influencing the development of CFS. These findings enhance our understanding of how lipid levels and immune factors are related to CFS and how dietary choices can potentially mitigate the syndrome.

Sodium

Beyond the Average: Trends in Extreme Sodium Intake in the U.S. Population, 2003–2018

Yutong Chen, Jingyan Wang, Kristin E. Leonberg, Kenneth Kwan Ho Chui, Lynne M. Ausman, Elena N. Naumova. *Nutrients,* 17 (12), 11 June 2025. doi.org/10.3390/nu17121975. Article link

Background: Excessive sodium consumption is a major contributor to hypertension and cardiovascular disease (CVD), yet most nutrition surveillance systems focus primarily on average intake measurements, neglecting patterns of extreme sodium consumption. Public health strategies need to consider how high sodium intake patterns evolve across the entire population over time. Objective: The study analyzed sodium consumption patterns across US populations through NHANES data from 2003 to 2018 while focusing on percentiles and extreme consumption levels. The study evaluated the accelerations and decelerations of sodium consumption while analyzing its trends in vulnerable groups (people with self-reported hypertension, CVD, heart attack, and stroke) along with chronological time and age changes. **Methods:** The analysis of NHANES data involved 60,663 participants between ages 5–80 years from eight survey cycles (2003–2018). The research used non-linear Gaussian regression to model sodium intake (mg/day) with age and the NHANES cycle treated as continuous predictor variables. We classified intake curves into four main intake patterns, increase with acceleration (IA), increase with deceleration (ID), decrease with acceleration (DA), and decrease with deceleration (DD), and estimated turning points to reflect critical risk periods in 16 selected subgroups defined by age, sex, and self-reported health conditions. We also examined temporal trends in intake extremes through individual-level and population-level data. **Results:** In most adult subgroups, we observed a non-linear pattern over time, indicating that sodium intake initially increased and then plateaued or declined around the turning point of ~20–30 years. Only girls demonstrated a steady decline in sodium intake over time, while in boys, we detected an alarming accelerating increase. The intake at upper percentiles remained extremely high: approximately 10% of the population consumed more than 5000 mg of sodium per day, which is more than twice the recommended limit of 2300 mg/day. Participants with CVD, heart attack, and stroke had a lower average intake than those without, but intake remained above recommended levels. **Conclusions:** From 2003 to 2018, sodium intake in the U.S. showed no signs of meaningful decline, especially at the upper extreme. These findings suggest that current efforts are insufficient to meet the WHO's global target of a 30% sodium reduction by 2030.

Gut Health

Fecal Microbiota and Metabolites Predict Metabolic Health Features

Alexis D Baldeon, Tori A Holthaus, Naiman A Khan, Hannah D Holscher. *Jrnl of Nutrition*, Vol. 155, Issue 6, June 2025. doi.org/10.1016/j.tjnut.2025.03.024. Article link

Background: Consuming healthful dietary patterns reduces risk of developing metabolic diseases and nourishes the intestinal microbiota. Thus, investigating the microbial underpinnings of dietary influences on metabolic health is of clinical interest. **Objectives:** This study aimed to determine the unique contributions of fecal taxa and metabolites in predicting metabolic health markers in adults across various dietary patterns. **Methods:** Dietary, metabolic, and fecal microbiota and metabolome data from 118 adults (25–45 y) were used for these cross-sectional analyses. The Diet History Questionnaire II assessed adherence to the dietary approaches to stop hypertension (DASH), Mediterranean diet, Mediterranean-DASH intervention for neurocognitive delay (MIND), and the Healthy Eating Index-2020 (HEI-2020). Metabolic features included waist circumference, blood pressure, and circulating triglyceride (TG), high-density lipoprotein cholesterol, and glucose concentrations. Microbiota composition was assessed via 16S amplicon sequencing and volatile fatty acid and bile acid concentrations were measured by targeted metabolomics. Analyses of compositions with bias correction 2 (ANCOM-BC2) and correlation analyses were used to screen for microbiota features independently associated with dietary patterns and metabolic health markers. Then, hierarchical linear regression models were used to evaluate the unique contributions of select microbial features on metabolic markers beyond adherence to dietary patterns. **Results:** HEI-2020 positively associated with microbiota richness ($P = 0.02$). Beta diversity varied across all dietary patterns ($P < 0.05$). DASH diet scores, *Eubacterium xylanophilum* abundance, and deoxycholic acid concentration explained the most variance in systolic ($R2 = 0.32$) and diastolic ($R2 = 0.26$) blood pressure compared with other dietary patterns and microbial features. TG concentrations were best predicted by MIND diet scores, *E eligens* abundance, and isobutyrate concentrations ($R2 = 0.24$). **Conclusions:** Integrating fecal taxa and metabolites alongside dietary indices improved metabolic health marker prediction. These results point to a potential role of the intestinal microbiota in underpinning physiological responses to diet and highlight potential microbial biomarkers of metabolic health.

Emerging Science Areas

Emerging Science Areas: Lycopene and Mental Health

Influence of Lycopene Intake on Mental Health: A Systematic Review of Randomized Controlled Trials (RCTs)

Dominika Głabska, Dominika Guzek, Anna Jílková, Aleksandra Kołota-Burdzy, Dominika Skolmowska, Lenka Kouˇrimská. *Nutrients,* 2025, Vol. 17, Issue 11. doi.org/10.3390/nu17111793. Article link

Background: The potential influence of lycopene on mental health was indicated in some studies, but it was not summarized within any systematic review so far. The aim of the presented study was to analyze the influence of lycopene on mental health within a systematic review of Randomized Controlled Trials (RCTs). **Methods:** The study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, and it was based on PubMed, Web of Science, Cochrane, and Google Scholar databases, while the RCTs published until February 2025 were included. The systematic review was registered within the database of the International Prospective Register of Systematic Reviews (PROSPERO) (CRD420250650525). The studies were considered where the adult population was studied; intervention was based on oral lycopene intake in any form (lycopene supplement, lycopene-enriched functional food, or regular food product being an important source of lycopene); lycopene intake of a specified dose was applied; any mental health result was studied using a valid psychological measure. After duplicate removal, 642 studies were screened, and finally, six RCTs were included and assessed using the revised Cochrane risk-of-bias tool for randomized trials, while various mental health outcomes were allowed (excluding subjects with intellectual disabilities, eating disorders, and neurological disorders). Each stage of screening, inclusion, reporting, and assessment was conducted independently by two researchers. **Results:** The included studies were conducted in populations of healthy individuals (one study), but mainly in individuals with various diseases: Benign Prostatic Hyperplasia (BPH) (two studies), Burning Mouth Syndrome (BMS) (one study), xerostomia (one study), and infertility (one study). Within the included studies, various lycopene sources were applied, including lycopene supplements, functional foods, and regular food products, as well as various lycopene doses from 1.35 mg to 27.8 mg per day. The included studies assessed quality of life (five studies), depression and anxiety (two studies), stress (two studies), and mood states (one study). In spite of the fact that all six included studies were RCTs, the comparison between the intervention group and placebo group was made in only four studies, and none of them stated the difference between the compared groups. A low risk of bias was concluded for three studies (all of them not confirming the influence of lycopene on mental health), and a high risk of bias was found in three studies (one of them not confirming, and two not conclusive). **Conclusions:** The evidence gathered within the systematic review of RCTs did not confirm any influence of lycopene on mental health. Further RCTs are needed to verify the influence of lycopene provided within supplements, functional foods, and regular food products on various mental health problems in diverse populations.

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July 7, 2025
Virtual, Event

- https://iafns.org/event/dialogue-on-measures-of-gut-brain-axis-effects-with-david-vauzour/

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July 7, 2025
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- https://iafns.org/event/dialogue-on-measuring-subclinical-cognitive-decline/

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IAFNS will be presenting at the IFT FIRST Scientific & Technical Forum on Bridging the Gap Between Diet & Public Health: A Dialogue about Sodium.

- https://iafns.org/event/ift-first-scientific-technical-forum/

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The IAFNS Food Microbiology Committee and Food & Chemical Safety Committee are presenting 3 sessions at the International Association for Food Protection 2025.

- https://iafns.org/event/iafp-2025/