Nutrition Briefs

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Dietary Patterns

Experimental Capacity of Human Fecal Microbiota to Degrade Fiber and Produce Short-Chain Fatty Acids Is Associated with Diet Quality and Anthropometric Parameters

Anna M Malinowska, Malgorzata Majcher, Guido Jej Hooiveld, Hanna Przydatek, Marta Szaban, Agata Kurowiecka, Marcin Schmidt. *J Nutr*. 2023 Aug 10;S0022-3166(23)72531-5. doi: 10.1016/j.tjnut.2023.08.007. Article link

Significance: A cross-sectional study of 200 adults confirmed the positive link between high fiber dietary intake and fecal microbiota capacity to degrade soluble and insoluble dietary fiber, suggesting the importance of eating healthy foods for enhanced microbial production of propionic acid.

Background: Short-chain fatty acids (SCFAs) are considered beneficial to human health. The associations between bacterial capacity to produce SCFAs, diet, and health are not fully understood. **Objective:** We aimed to evaluate the capacity of human fecal microbiota to produce SCFAs and to metabolize soluble and insoluble fiber and to study its associations with human diet, anthropometric parameters, and carbohydrate and lipid metabolism. **Methods:** A cross-sectional study was carried out with 200 adult participants. Diet was evaluated using food records. Capacity to produce acetate, butyrate, and propionate and to degrade soluble fiber were assessed in an ex vivo experiment where fecal samples were inoculated in a pectin-containing broth. Fecal β-glucosidase activity was measured to assess potential to degrade insoluble fiber. **Results:** The main dietary determinants of high capacity to metabolize fiber were high intake of vegetables, fruits, nuts, and seeds. After adjusting analyses for confounders, glucose and lipid parameters were not significantly associated with any of the studied microbial capacities, but the capacity to produce propionic acid was significantly associated with hip circumference (β = -0.018, P = 0.044), which was seen especially in people eating healthy. **Conclusions:** We confirmed that high intake of fiber-rich products is positively associated with the capacity of fecal microbiota to degrade soluble and insoluble dietary fiber and that people eating healthy food might benefit from enhanced microbial capacity to produce propionic acid.

Bioactives

Protective Effects of Micronutrient Supplements, Phytochemicals and Phytochemical-Rich Beverages and Foods Against DNA Damage in Humans: A Systematic Review of Randomized Controlled Trials and Prospective Studies

Michael F Fenech, Caroline F Bull, Jan-Willem Van Klinken. *Adv Nutr*. 2023 Aug 18;S2161-8313(23)01354-6. doi: 10.1016/j.advnut.2023.08.004. Article link

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Significance: This review highlighted the selective importance of certain nutrients and bioactives for DNA metabolism and repair and oxidative stress and inflammation prevention. This suggests supplementation of selective micronutrients may help promote cellular health and maintain genome integrity.

Accumulation of deoxyribonucleic acid (DNA) damage diminishes cellular health, increases risk of developmental and degenerative diseases, and accelerates aging. Optimizing nutrient intake can minimize accrual of DNA damage. The objectives of this review are to: 1) assemble and systematically analyze high-level evidence for the effect of supplementation with micronutrients and phytochemicals on baseline levels of DNA damage in humans and 2) use this knowledge to identify which of these essential micronutrients or nonessential phytochemicals promote DNA integrity in vivo in humans. We conducted systematic literature searches of the PubMed database to identify interventional, prospective, cross-sectional, or in vitro studies that explored the association between nutrients and established biomarkers of DNA damage associated with developmental and degenerative disease risk. Biomarkers included lymphocyte chromosome aberrations, lymphocyte and buccal cell micronuclei, DNA methylation, lymphocyte/leukocyte DNA strand breaks, DNA oxidation, telomere length, telomerase activity, and mitochondrial DNA mutations. Only randomized, controlled interventions and uncontrolled longitudinal intervention studies conducted in humans were selected for evaluation and data extraction. These studies were ranked for the quality of their study design. In all, 96 of the 124 articles identified reported studies that achieved a quality assessment score ≥ 5 (from a maximum score of 7) and were included in the final review. Based on these studies, nutrients associated with protective effects included vitamin A and its precursor β-carotene, vitamins C, E, B1, B12, folate, minerals selenium and zinc, and phytochemicals such as curcumin (with piperine), lycopene, and proanthocyanidins. These findings highlight the importance of nutrients involved in (i) DNA metabolism and repair (folate, vitamin B12, and zinc) and (ii) prevention of oxidative stress and inflammation (vitamins A, C, E, lycopene, curcumin, proanthocyanidins, selenium, and zinc). Supplementation with certain micronutrients and their combinations may reduce DNA damage and promote cellular health by improving the maintenance of genome integrity.

Protein

Evaluation of Protein Requirements Using the Indicator Amino Acid Oxidation Method: A Scoping Review

Mai Matsumoto, Aiko Narumi-Hyakutake, Yuya Kakutani, Masayoshi Tsuji, Yoichi Hatamoto, Yasuki Higaki, Satoshi Sasaki. *J Nutr.* 2023 Aug 10;S0022-3166(23)72529-7. doi: 10.1016/j.tjnut.2023.07.015. Article link

Significance: An evaluation of 16 studies found that protein requirements measured by the IAAO method provided higher protein requirement value compared to current reference value for each sex, life stage and physical activity. This finding suggests the IAAO method could be used for protein requirements assessment of various populations including gender and life stage.

Background: The indicator amino acid oxidation (IAAO) method has been accepted as an approach to evaluate habitual protein requirements under free-living conditions. **Objectives:** This scoping review reports on literature that evaluated protein requirements in humans using the IAAO methods. **Methods:** Three databases (PubMed/Medline, Web of Science, and ProQuest) were systematically searched to identify studies that evaluated protein requirements using the IAAO method published in English until 5 June 2023. We evaluated the study quality using previously developed criteria. We extracted the characteristics of the study design and the results of protein requirements. Two reviewers conducted both reviews and quality assessments independently; any differences among them were resolved by consensus or agreement of all team members. **Results:** We extracted 16 articles targeting children, young adults (including pregnant women, resistance training athletes, endurance-training athletes, and team sports), and older adults. In quality assessment, 14 studies were evaluated "strong," but the remaining 2 were "moderate." These studies were conducted in only 3 countries and did not include all sexes or life stages. The range of the estimated average protein requirements of each life stage was 1.3 g/kg body weight/d for children, 0.87 to 2.1 (0.87-0.93 for general young adults, 1.22-1.52 for pregnant women, 1.49-2.0 for resistance-trained athletes, 1.65-2.1 for endurance athletes, and 1.2-1.41 for team sports athletes) g/kg body weight/d for young adults, and 0.85 to 0.96 g/kg body weight/d for older adults **Conclusions:** Protein requirements in 14 studies were higher than the current reference for each sex, life stage, and physical activity that are related to protein requirements. In the future, protein requirements of various populations including sex and life stage could be assessed using the IAAO methods worldwide.

Low- and No-Calorie Sweeteners

Association Between Non-Nutritive Sweetener Consumption and Liver Enzyme Levels in Adults: A Systematic Review and Meta-Analysis of Randomized Clinical Trials

S Amirhossein Golzan, Mina Movahedian, Neda Haghighat, Omid Asbaghi, Azita Hekmatdoost. *Nutr Rev*. 2023 Aug 10;81(9):1105-1117. doi: 10.1093/nutrit/nuac107. Article link

Significance: A new systematic review found non-nutritive sweetener intake has no significant impact on liver enzyme levels in adults.

Context: The use of non-nutritive sweeteners (NNSs) is dramatically increasing in food commodities, and their effects on biochemical parameters have been the subject of great controversy. Liver enzymes as markers of liver injury may be helpful measures of non-alcoholic fatty liver disease (NAFLD), but the outcomes of randomized controlled trials (RCTs) suggest their associations with NNSs are contentious. **Objective:** The current study was designed to provide a GRADE-assessed systematic review and meta-analysis of RCTs studying the consequences of NNS consumption on ALT, AST, and GGT concentrations (ie, the 3 main liver enzymes in adults).

Data Sources: Scopus, PubMed, and EMBASE were searched for relevant studies up to April 2021, with no time and language limitations. **Data Extraction:** Two independent researchers extracted information from qualified studies, and a third researcher rechecked it.

Data Analysis: Of 3212 studies, 10 studies enrolled a total of 854 volunteers were included. A random-effects or fixed-effects model was utilized to calculate weighted mean differences (WMDs) and 95% confidence intervals (CIs). Heterogeneity between studies was evaluated using Cochran's Q test and quantified using the I2 statistic. The pooled results demonstrated that, compared with control groups, NNS intake led to nonsignificant reductions in ALT (WMD: -.78, 95% CI: -2.14, .57, P = .25) and GGT (WMD: -.21, 95% CI: -1.46, 1.04, P = .74). Also, a small nonsignificant increasing effect on AST level was found (WMD: .02, 95% CI: -1.26, 1.30, P = .97). NNS significantly reduced AST levels in type 2 diabetes patients when subgroup analyses were performed. Also, in trials with ≥24-week intervention or studies that utilized stevioside for intervention, a significant reducing effect on ALT level was observed. **Conclusion:** The results of this study showed that NNS intake has no significant effect on liver enzyme levels in adults.

Cognitive Health

Higher Versus Lower Nut Consumption and Changes in Cognitive Performance over Two Years in a Population at Risk of Cognitive Decline: A Cohort Study

Jiaqi Ni, Stephanie K Nishi, Nancy Babio, Emilio Ros, F Javier Basterra-Gortari, Dolores Corella, et. al. *Am J Clin Nutr*. 2023 Aug;118(2):360-368. doi: 10.1016/j.ajcnut.2023.05.032. Article link

Significance: Frequent nut consumption was linked to smaller decline in general cognitive performance in a 2-year study with older adults. Future randomized controlled studies will be necessary to further verify these findings.

Background: Tree nuts and peanuts (henceforth, nuts) are nutrient-dense foods rich in neuroprotective components; thus, their consumption could benefit cognitive health. However, evidence to date is limited and inconsistent regarding the potential benefits of nuts for cognitive function. **Objective:** To prospectively evaluate the association between nut consumption and 2-y changes in cognitive performance in older adults at cognitive decline risk. **Methods:** A total of 6,630 participants aged 55 to 75 y (mean age 65.0±4.9 y, 48.4% women) with overweight/obesity and metabolic syndrome completed a validated semi-quantitative food frequency questionnaire and a comprehensive battery of neuropsychological tests at baseline and a 2-y follow-up. Composite cognitive scores were used to assess global, general, attention, and executive function domains. Nut consumption was categorized as <1, ≥1 to <3, ≥3 to <7, and ≥7 servings/wk (1 serving=30 g). Multivariable-adjusted linear regression models were fitted to assess associations between baseline nut consumption and 2-y cognitive changes. **Results:** Nut consumption was positively associated with 2-y changes in general cognitive function (P-trend <0.001). Compared with participants consuming <1 serving/wk of nuts, those categorized as consuming ≥3 to <7 and ≥7 servings/wk showed more favorable changes in general cognitive performance (β z-score [95% CI] = 0.06 [0.00,0.12] and 0.13 [0.06,0.20], respectively). No significant changes were observed in the multivariable-adjusted models for other cognitive domains assessed.

Conclusion: Frequent nut consumption was associated with a smaller decline in general cognitive performance over 2 y in older adults at risk of cognitive decline. Randomized clinical trials to verify our findings are warranted.

Lipids

The Roles of Lipid Metabolism in the Pathogenesis of Chronic Diseases in the Elderly

Rui Song, Mengxiao Hu, Xiyu Qin, Lili Qiu, Pengjie Wang, Xiaoxu Zhang, Rong Liu, Xiaoyu Wang. *Nutrients*. 2023 Aug 3;15(15):3433. doi: 10.3390/nu15153433. Article link

Significance: This review provides a summary of age-related changes in lipid metabolism related to lipid digestion, absorption, anabolism and catabolism, and associations with chronic disease.

Lipid metabolism plays crucial roles in cellular processes such as hormone synthesis, energy production, and fat storage. Older adults are at risk of dysregulation of lipid metabolism, which is associated with progressive declines in the physiological function of various organs. With advancing age, digestion and absorption commonly change, thereby resulting in decreased nutrient uptake. However, in the elderly population, the accumulation of excess fat becomes more pronounced due to a decline in the body's capacity to utilize lipids effectively. This is characterized by enhanced adipocyte synthesis and reduced breakdown, along with diminished peripheral tissue utilization capacity. Excessive lipid accumulation in the body, which manifests as hyperlipidemia and accumulated visceral fat, is linked to several chronic lipid-related diseases, including cardiovascular disease, type 2 diabetes, obesity, and nonalcoholic fatty liver disease. This review provides a summary of the altered lipid metabolism during aging, including lipid digestion, absorption, anabolism, and catabolism, as well as their associations with age-related chronic diseases, which aids in developing nutritional interventions for older adults to prevent or alleviate age-related chronic diseases.

Sodium

Outcomes of a State-Wide Salt Reduction Initiative in Adults Living in Victoria, Australia

Kristy A Bolton, Joseph Alvin Santos, Emalie Rosewarne, Kathy Trieu, Jenny Reimers, Caryl Nowson, Bruce Neal, et. al. *Eur J Nutr*. 2023 Oct;62(7):3055-3067. doi: 10.1007/s00394-023-03210-z. Article link

Significance: No clear population salt reduction intake effect was found in a 4-year study with adult participants in Victoria, Australia, in spite of multiple intervention approaches (awareness advertising, public debates, strengthening policy initiatives, food innovation). This finding suggests more intensive and sustained support is needed at the industry and national level to achieve a measurable reduction in salt intake.

Purpose: To assess any effects of a state-wide sodium reduction intervention on sodium intake, sources of dietary sodium and discretionary salt use at a population level. **Methods:** Data (24-h urinary sodium excretion, self-report survey, a 24-h dietary recall) were collected cross-sectionally at baseline (2016/2017) and follow-up (2020) from adults in Victoria, Australia. Intervention activities included consumer awareness advertising campaign, public debate generation via mass media, strengthening existing policy initiatives and supporting food innovation with industry. **Results:** There were 339 participants at baseline and 211 at follow-up, with 144 and 90 of participants completing a 24-h dietary recall, respectively. There was no difference in adjusted 24-h urinary sodium excretion between baseline and follow-up (134 vs 131 mmol/24 h; $p = 0.260$). There were no differences in the percentage of participants adding salt during cooking (63% vs 68%; $p = 0.244$), adding salt at the table (34% vs 37%; $p = 0.400$) or regularly taking action to control salt/sodium intake (22% vs 21%; $p = 0.793$). There were large differences in the quantity of dietary sodium sourced from retail stores (57% vs 77%, $p < 0.001$), and less sodium was sourced from foods at fresh food markets (13% vs 2%; $p \leq 0.001$) at follow-up. No large differences were apparent for foods with different levels of processing or for food groups. **Conclusion:** There was no clear population-level effect of the 4-year multi-component Victorian Salt Reduction Intervention on sodium intake with Victorian adults continuing to consume sodium above recommended levels. The findings indicate that more intensive and sustained efforts aiming at the retail and food industry with national level support are likely to be required to achieve a measurable improvement in sodium intake at a state level.

Gut Microbiome

Perspective: Challenges and Future Directions in Clinical Research with Nuts and Berries

Zuelch ML, Radtke MD, Holt RR, Basu A, Burton-Freeman B, Ferruzzi MG, Li Z, et. al. *Adv Nutr.* 2023 Aug 2:S2161-8313(23)01349-2. doi: 10.1016/j.advnut.2023.07.010. Article link

Significance: A perspective review provides new insights into bioactive compounds like nuts and berries important for precision nutrition and challenges related to outcomes generalization, design inconsistencies, population homogeneity, test product variability as well as future research and technology needs.

Consumption of nuts and berries are considered part of a healthy eating pattern. Nuts and berries contain a complex nutrient profile consisting of essential vitamins and minerals, fiber, polyunsaturated fatty acids, and phenolics in quantities that improve physiological outcomes. The spectrum of health outcomes that may be impacted by the consumption of nuts and berries includes cardiovascular, gut microbiome and cognitive, among others. Recently, new insights regarding the bioactive compounds found in both nuts and berries have reinforced their role for use in precision nutrition efforts. However, challenges exist that can affect the generalizability of outcomes from clinical studies, including inconsistency in study designs, homogeneity of test populations, variability in test products and control foods, and assessing realistic portion sizes. Future research centered on precision nutrition and multi-omics technologies will yield new insights. These and other topics such as funding streams and perceived risk-of-bias were explored at an international nutrition conference focused on the role of nuts and berries in clinical nutrition. Successes, challenges, and future directions with these foods are presented here.

Emerging Science Areas

Emerging Areas: Sound Precision Nutrition

Precision Nutrition: The Hype Is Exceeding the Science and Evidentiary Standards Needed to Inform Public Health Recommendations for Prevention of Chronic Disease

Regan L. Bailey and Patrick J. Stover. *Annu. Rev. Nutr.* 2023. 43:385–407

doi.org/10.1146/annurev-nutr-061021-025153. Article link

Significance: This paper provides an interesting and novel perspective on precision nutrition in establishing dietary guidance for nutrient deficiency and chronic disease risk reduction. More precision is needed for establishing essential nutrient/food substance throughout the life cycle for health, diseases, healthy aging and eating behaviors. The authors also provide a template for guiding population-based eating recommendations for reducing chronic diseases in heterogenous populations.

As dietary guidance for populations shifts from preventing deficiency disorders to chronic disease risk reduction, the biology supporting such guidance becomes more complex due to the multifactorial risk profile of disease and inherent population heterogeneity in the diet–disease relationship. Diet is a primary driver of chronic disease risk, and population-based guidance should account for individual responses. Cascading effects on evidentiary standards for population-based guidance are not straightforward. Precision remains a consideration for dietary guidance to prevent deficiency through the identification of population subgroups with unique nutritional needs. Reducing chronic disease through diet requires greater precision in (a) establishing essential nutrient needs throughout the life cycle in both health and disease; (b) considering effects of nutrients and other food substances on metabolic, immunological, inflammatory, and other physiological responses supporting healthy aging; and (c) considering healthy eating behaviors. Herein we provide a template for guiding population-based eating recommendations for reducing chronic diseases in heterogenous populations.

Engage with IAFNS

Beneficial Live Dietary Microbes: Is it Time for Recommended Intakes?
September 28, 2023
Virtual, Event
Evidence from human microbiome research, randomized controlled trials testing interventions containing probiotics on preventive and therapeutic endpoints, and associative studies linking fermented food consumption with improved health, all point to the value of the consumption of live microbes for supporting human health.
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USDA Webinar Series – Western Human Nutrition Research Center
October 11, 2023 – October 24, 2023
Virtual, Event
Read more.

The Promise and Hype of AI: Where Are We – And Where Are We Going?
October 17, 2023.
Virtual, USA
Despite questions around their responsible use, ChatGPT and other AI tools are currently being implemented from education to business to research, with even more transformational advances on the horizon.
Read more.

2023 Science Innovation Showcase
December 12, 2023 – December 14, 2023
Virtual, Event
This science-first and science-focused event brings together scientists from multiple sectors, at all stages of their careers from graduate students to professors, technical experts to CEOs.
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