Nutrition Briefs

Dietary Patterns

Dietary Patterns and Practices and Leucocyte Telomere Length: Findings from the UK Biobank.

Vasiliki Bountziouka, Christopher P Nelson, Qingning Wang, Crispin Musicha, Veryan Codd, Nilesh J Samani. J *Acad Nutr Diet*. 2023 Jan 17;S2212-2672(23)00017-5. doi: 10.1016/j.jand.2023.01.008. **Article link**

Significance: A cross-sectional study found a positive association between longer leucocyte telomere length (LTL) and the Mediterranean, Prudent, or 5-a-day dietary patterns. In contrast, a negative correlation was found between LTL and Meat patterns, and no correlation between LTL and vegetarian patterns.

Background: Shorter telomere length (TL) is associated with risk of several age-related diseases and decreased lifespan, but the extent to which dietary patterns and practices associate with TL is uncertain. **Objective:** This study aimed to investigate the association of dietary patterns and practices and leucocyte TL (LTL). **Design**: This was a cross-sectional study. **Participants:** Data collected voluntarily from up to 422,797 UK Biobank participants, during 2006-2010. Main Outcome Measures: LTL was measured as a ratio of the telomere repeat number to a single-copy gene and was loge-transformed and standardized (z-LTL). **Statistical Analysis**: A-priori adherence to the Mediterranean diet was assessed through the MedDietScore. Principal component analysis was used to a-posteriori extract the "Meat" and "Prudent" dietary patterns. Additional dietary practices considered were the self-reported adherence to "Vegetarian" diet, "Eating 5-a-day of fruit and vegetables" and "Abstaining from eggs/dairy/wheat/sugar". Associations between quintiles of dietary patterns or adherence to dietary practices with z-LTL were investigated through multivariable linear regression models (adjusted for demographic, lifestyle and clinical characteristics). **Results:** Adherence to the "Mediterranean" and the "Prudent" patterns, was positively associated with LTL, with an effect magnitude in z-LTL of 0.020SD and 0.014SD, respectively, for the highest vs the lowest quintile of adherence to the pattern (both P<0.05). Conversely, a reversed association between quintile of the "Meat" pattern and LTL was observed, with z-LTL being on average shorter by 0.025SD (P=6.12x10-05) for participants in the highest quintile of the pattern compared to the lowest quintile. For adherents to "5-a-day" z-LTL was on average longer by 0.027SD (P=5.36x10-09), and for "abstainers", LTL was shorter by 0.016SD (P=2.51x10-04). The association of LTL with a vegetarian diet was non-significant after adjustment for demographic, lifestyle, and clinical characteristics. **Conclusion:** Several dietary patterns and practices, associated with beneficial health effects, are significantly associated with longer LTL. However, the magnitude of the association was small, and any clinical relevance is uncertain.

Carbohydrates

Structural Elucidation Approaches in Carbohydrates: A Comprehensive Review on Techniques and Future Trends

Yuning Liu, Yajun Huang, Ruiyu Zhu, Mohamed A Farag, Esra Capanoglu, Chao Zhao. *Food Chem*. 2023 Jan 30;400:134118. doi: 10.1016/j.foodchem.2022.134118. **Article link**

Significance: This comprehensive review discusses limitations in current carbohydrate technologies in assessing health and pharmacological impact, and the need for improvements in analytical developments.

Carbohydrates and their implications for human health have been the subject to a rapidly growing interest. Substantial advances in analytical methods have enabled a more effective assessment of carbohydrates and their pharmacological effects. Developing a carbohydrate profile technology would surely aid the understanding of carbohydrate dietary impacts. With the advances in technology for characterization, as well as exploration of

complex structure, it is becoming more feasible to synthesize such compounds, rather than isolation. Several technological developments, including improved analytical tools, glycomics, and automation technology, have opened new opportunities to globally assess most carbohydrates in envisaged samples. The main analytical methods applied to carbohydrates are described. And then the development of automation technology in glycan synthesis are introduced. This review concludes by considering the limitations of the existing technologies and required future developments for overcoming these limitations and improving identification score and/or yield.

Protein

Alternative Dietary Protein Sources to Support Healthy and Active Skeletal Muscle Aging

Ino van der Heijden, Alistair J Monteyne, Francis B Stephens, Benjamin T Wall. *Nutr Rev.* 2023 Jan 10;81(2):206-230. doi: 10.1093/nutrit/nuac049. **Article link**

Significance: This review provided an in-depth assessment of the current evidence base for use of alternative protein sources (plants, fungi, insects, algae, and lab-grown 'meat') to support muscle anabolism in (active) older adults. Expansion of the current database is necessary to support any future refinements in nutritional guidelines for healthy and active aging people.

To mitigate the age-related decline in skeletal muscle quantity and quality, and the associated negative health outcomes, it has been proposed that dietary protein recommendations for older adults should be increased alongside an active lifestyle and/or structured exercise training. Concomitantly, there are growing environmental concerns associated with the production of animal-based dietary protein sources. The question therefore arises as to where this dietary protein required for meeting the protein demands of the rapidly aging global population should (or could) be obtained. Various non-animal-derived protein sources possess favorable sustainability credentials, though much less is known (compared with animal-derived proteins) about their ability to influence muscle anabolism. It is also likely that the anabolic potential of various alternative protein sources varies markedly, with the majority of options remaining to be investigated. The purpose of this review was to thoroughly assess the current evidence base for the utility of alternative protein sources (plants, fungi, insects, algae, and lab-grown "meat") to support muscle anabolism in (active) older adults. The solid existing data portfolio requires considerable expansion to encompass the strategic evaluation of the various types of dietary protein sources. Such data will ultimately be necessary to support desirable alterations and refinements in nutritional guidelines to support healthy and active aging, while concomitantly securing a sustainable food future.

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 Jan 9;nuac107. doi: 10.1093/nutrit/nuac107. **Article link**

Significance: A systematic review and meta-analysis of randomized trials found that in adults intake of NNS has no significant effect on three liver enzyme levels (ALT, AST, and GGT) related to liver damage.

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 (i.e., 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 that 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

MIND Dietary Pattern Adherence is Selectively Associated with Cognitive Processing Speed in Middle-Aged Adults

Tori A Holthaus, Monica Kashi, Corinne N Cannavale, Caitlyn G Edwards, Susan Aguiñaga, Anne D M Walk, Nicholas A Burd, Hannah D Holscher. *J Nutr*. 2023 Jan 14;152(12):2941-2949. doi: 10.1093/jn/nxac203. **Article link**

Significance: Adherence to the MIND diet was associated with faster information processing speed in middle-aged adults with healthy to obese BMI and particularly beneficial when cognitive control demands are increased. Further studies are warranted to study the effects of consuming a MIND diet on healthy cognitive aging.

Background: Most previous work has focused on a single-nutrient, bottom-up approach when examining the influence of diet on neurocognition. Thus, the impact of dietary patterns on cognitive health is under investigation. **Objectives:** We aimed to investigate the relation between different diet indices [i.e., Mediterranean, Dietary Approaches to Stop Hypertension (DASH), Healthy Eating Index-2015 (HEI-2015), and Mediterranean-DASH Intervention for Neurodegenerative Delay (MIND)] and attentional inhibition and neuroelectric function. **Methods:** We undertook a cross-sectional analysis of adults aged 34.1 ± 6.0 y (n = 207, 116 females) with a BMI of 18.5 to >40 kg/m2 who completed the Dietary History Questionnaire II (DHQII) FFQ (Past Month and Year with Serving Sizes) to assess adherence to different diet quality indices. Attentional inhibition was assessed using a modified Eriksen flanker task during which event-related potentials (ERPs) were recorded. The amplitude and latency of the P3/P300 ERP were used to index attentional resource allocation and information processing speed, respectively. **Results**: P3 peak latency was inversely associated with greater adherence to the MIND dietary pattern during incongruent flanker trials ($\Delta R2 = 0.02$, $\beta = -0.14$, P = 0.043) but not during congruent trials. Adherence to the Mediterranean, DASH, and HEI-2015 patterns was not associated with P3 latency (P > 0.05). No associations were observed between the diet indices and attentional inhibition at the behavioral level (i.e., accuracy or reaction time) or P3 amplitude (all P values >0.05). **Conclusions:** Greater adherence to the MIND diet was selectively associated with faster information processing speed in middle-aged adults with healthy to obese BMI. Further, the influence of the MIND diet for faster information processing speed might be particularly beneficial when cognitive control demands are increased. Future intervention trials testing the effects of consuming a MIND diet on cognitive function are warranted to help inform dietary recommendations for healthy cognitive aging.

Association between Maternal Choline, Fetal Brain Development, and Child Neurocognition: Systematic Review and Meta-Analysis of Human Studies

Rima Obeid, Emma Derbyshire, Christiane Schön. *Adv Nutr*. 2022 Dec 22;13(6):2445-2457. doi: 10.1093/advances/nmac082. **Article link**

Significance: Low maternal choline intake could increase the risk of developing neutral tube defect by 2.36-fold. Higher maternal choline intake is associated with better child neurocognition/neurodevelopment. These findings could be helpful in guiding recommended choline intakes during pregnancy and lactation.

We studied associations between prenatal and early postnatal choline intake, brain development, and neurocognitive function of children. We conducted a systematic review followed by a meta-analysis and critical appraisal of human studies published from 1997 to 2021. Thirty publications were identified. The meta-analysis included 5 of 7 case-control studies studying neural tube defects (NTDs) in relation to maternal choline intakes/circulating concentrations. Low maternal choline intake/circulating concentrations were associated with a higher OR for NTDs among 1131 mothers of newborns with NTDs and 4439 control mothers (pooled estimate = 1.36; 95% CI: 1.11, 1.67). The 95% prediction intervals were 0.78, 2.36. Findings and critical evaluation of 10 publications with interventional designs showed that higher maternal choline intakes during the second half of pregnancy and early postnatal period (550 mg up to 1 g/d on top of the diet) or a child intake of 513 to 625 mg/d from supplements were safe and likely to demonstrate favorable effects on several domains of child neurocognition, such as memory, attention, and visuospatial learning versus the comparators. Findings from observational studies (n = 13) partly supported the association between maternal choline intake/serum concentrations and child neurocognition, but there was low confidence in the use of plasma choline concentrations as a choline intake marker. In conclusion, low maternal choline intake was associated with a higher OR for NTDs. The risk could be up to 2.36-fold in some populations. Despite limitations of available trials and observational studies, higher maternal choline intake was likely to be associated with better child neurocognition/neurodevelopment. The results should be used to guide

choline intake recommendations in pregnancy and lactation, especially because most young women are not achieving the reference intake of choline.

Lipids

Association of Branched Chain Fatty Acids with Cardiometabolic Disorders in Humans: A Systematic Review

Nagam Anna Yehia, Kira Zhi Hua Lai, Zhila Semnani-Azad, Sonia Blanco Mejia, Richard P Bazinet, Jacqueline L Beaudry, Anthony J Hanley. *Nutr Rev*. 2023 Jan 10;81(2):180-190. doi: 10.1093/nutrit/nuac051. **Article link**

Significance: Current evidence from a systematic review suggests potential beneficial correlation of circulating BCFAs with certain cardiometabolic risk phenotypes. More human studies are needed to provide better clarity and understanding of the impact of BCFA on cardiometabolic disorders.

Context: Despite advances in treatments for cardiometabolic disorders such as type 2 diabetes mellitus and obesity, the increasing frequency of these conditions is of major clinical and public health concern. Therefore, primary prevention including diet and lifestyle approaches continues to play a key role in risk reduction. Meta-analyses of prospective cohort studies have documented inverse associations of dairy consumption with the incidence of different cardiometabolic disorders. Dairy is the largest dietary contributor of branched chain fatty acids (BCFAs), which have been suggested to not only serve as biomarkers of dairy consumption but may also have bioactive properties contributing to reducing the risk of cardiometabolic outcomes. To date, however, the literature on this topic has not been systematically reviewed. **Objective:** The aim here was to report the results of a systematic review of the association of BCFAs with cardiometabolic disorders in humans. Data Sources: Search terms were developed and run through the Ovid MEDLINE, Ovid Embase, and the Cochrane Library databases. Data Extraction: Articles were selected on the basis of prespecified inclusion criteria and assessed for risk of bias by independent reviewers. **Results:** Four studies (n = 2 cross sectional; n = 1 randomized feeding trial and n = 1 pre-post study) were identified. Two studies reported significant inverse associations between serum BCFAs and insulin resistance, triglycerides and/or body mass index. One study identified an inverse association between adipose tissue monomethyl BCFAs and skeletal muscle insulin resistance. In contrast, the randomized feeding trial reported no significant differences to stool BCFA concentrations or body mass index in obese participants following assignment to fruit-vegetable or whole-grain diet groups compared with a refined-grain control group. **Conclusions:** Current evidence suggests beneficial associations of circulating BCFAs with cardiometabolic risk phenotypes, although data in human participants are limited, indicating that additional research is required.

Sodium

Consumer Acceptance of Reduced Sodium White and Multigrain Bread: Impact of Flavor Enhancement and Ingredient Information on Sample Liking

Aubrey N Dunteman, Soo-Yeun Lee. *J Food Sci*. 2023 Jan;88(1):417-429. doi: 10.1111/1750-3841.16395. **Article link**

Significance: This consumer study found that liking for white and multigrain breads, where sodium has been reduced by 40 or 60 %, could be improved with monosodium glutamate added as a flavor enhancer.

Chronic consumption of sodium in quantities exceeding recommendations has led to sodium being designated as a nutrient of health concern for overconsumption. As a result of the prevalence of sodium overconsumption, the Food and Drug Administration (FDA) released voluntary sodium reduction goals for a wide variety of products on both short- and long-term timespans. As food palatability may decrease when sodium is reduced, flavor enhancers such as monosodium glutamate (MSG) may provide a promising solution to mitigate such palatability loss. The objective of this research was to investigate consumer acceptance of white and multigrain breads with either a 43% or 60% reduction in sodium content and with and without MSG as well as to investigate the influence of information on consumer acceptance of these breads under blind, informed, and informed with education conditions. Seventy-eight frequent bread consumers participated in the evaluations. A significant difference was evidenced across breads with different levels of sodium content and MSG status, although no difference was seen across the different evaluation conditions. Consumer segmentation found multiple consumer clusters showing different liking patterns of the bread treatments for both white and multigrain breads. Breads with sodium content set at the FDA's long-term goal with and without MSG were liked no differently in nearly all attributes evaluated than the full-sodium bread demonstrating the feasibility of producing acceptable reduced-sodium breads.

Future research characterizing the predominant sensory attributes of full-sodium and reduced-sodium breads with and without MSG would be valuable for identifying the drivers of liking in such products. **Practical Application**: The findings of our study suggest that consumer liking of reduced sodium white and multigrain breads could be improved with the addition of monosodium glutamate. Increasing the acceptance of reduced sodium food products could help to reduce the risk of hypertension and subsequently heart attacks and stroke for the American population.

Gut Microbiome

Fecal Metabolites as Biomarkers for Predicting Food Intake by Healthy Adults

Leila M Shinn, Aditya Mansharamani, David J Baer, Janet A Novotny, Craig S Charron, Naiman A Khan, Ruoqing Zhu, Hannah D Holscher. *J Nutr.* 2023 Jan 14;152(12):2956-2965. doi: 10.1093/jn/nxac195. **Article link**

Significance: A study using a multivariate, machine learning approach to identify metabolite biomarkers for food intake prediction found potential promise in the use of fecal metabolites as an objective complement to certain self-reported food intake estimates (47- 89% prediction accuracies in some foods). Future research will need to investigate foods at various doses, and with different dietary patterns.

Background: The fecal metabolome is affected by diet and includes metabolites generated by human and microbial metabolism. Advances in -omics technologies and analytic approaches have allowed researchers to identify metabolites and better utilize large data sets to generate usable information. One promising aspect of these advancements is the ability to determine objective biomarkers of food intake. **Objectives:** We aimed to utilize a multivariate, machine learning approach to identify metabolite biomarkers that accurately predict food intake. **Methods:** Data were aggregated from 5 controlled feeding studies in adults that tested the impact of specific foods (almonds, avocados, broccoli, walnuts, barley, and oats) on the gastrointestinal microbiota. Fecal samples underwent GC-MS metabolomic analysis; 344 metabolites were detected in preintervention samples, whereas 307 metabolites were detected postintervention. After removing metabolites that were only detected in either pre- or postintervention and those undetectable in ≥80% of samples in all study groups, changes in 96 metabolites relative concentrations (treatment postintervention minus preintervention) were utilized in random forest models to 1) examine the relation between food consumption and fecal metabolome changes and 2) rank the fecal metabolites by their predictive power (i.e., feature importance score). **Results:** Using the change in relative concentration of 96 fecal metabolites, 6 single-food random forest models for almond, avocado, broccoli, walnuts, whole-grain barley, and whole-grain oats revealed prediction accuracies between 47% and 89%. When comparing foods with one another, almond intake was differentiated from walnut intake with 91% classification accuracy. **Conclusions:** Our findings reveal promise in utilizing fecal metabolites as objective complements to certain self-reported food intake estimates. Future research on other foods at different doses and dietary patterns is needed to identify biomarkers that can be applied in feeding study compliance and clinical settings.

Emerging Science Areas

Emerging Category: Food and Nutrition Policies

Announcement of the 2025-2030 Dietary Guidelines for Americans.

https://www.dietaryguidelines.gov/submit-comment/attend-virtual-meetings

Significance: The 20 selected experts of the dietary guideline advisory committee (DGAC) will be tasked with examining the relationship between diet and health across all life stages, using a health equity lens to ensure factors such as socioeconomic status, race, ethnicity and culture are described and considered based on the scientific literature and data.

Highlights:

The Departments of Health and Human Services (HHS) and Agriculture (USDA) are pleased to announce the **20 nationally recognized scientific experts** who will serve on the 2025 Dietary Guidelines Advisory Committee. The **first Committee meeting** will be on February 9-10 and will be available to the public to attend virtually. A **public comment period** has been opened and will remain open throughout the Committee's work. The public is encouraged to provide comments to the Committee and virtually attend the Committee meetings online.

- See the full list of **Committee members.**

- Read more about the Dietary Guidelines process at **DietaryGuidelines.gov**

The Committee's work will culminate in a scientific report for the Secretaries of HHS and USDA to consider, along with public and agency comments, as the Departments develop the next edition of the Dietary Guidelines for Americans.

Emerging Category: Microbial Polyphenols and Dietary Patterns

Association of Microbiota Polyphenols with Cardiovascular Health in the Context of a Mediterranean Diet

Domínguez-López,Camila Arancibia-Riveros, María Marhuenda-Muñoz, Anna Tresserra Rimbau, Estefanía Toledo., Montserrat Fitó e, Emilio Ros f, Ramon Estruch g, Rosa M. Lamuela-Raventós. Food Res Intl. Vol. 165, March 2023, 112499. https://doi.org/10.1016/j.foodres.2023.112499. **Article link**

Significance: A cross-sectional sub-study from the PREDIMED trial found several urinary microbial phenolic metabolites (MPM) derived from gut microbial were associated with higher adherence to the Mediterranean diet (MedDiet) and Ideal cardiovascular health. Among individual polyphenols, urolithin B glucuronide (UBG) was inversely associated with LDL-cholesterol. These findings suggest a potential connection between diet, microbial metabolites and cardiovascular health.

Background and Aims. The Mediterranean diet (MedDiet) is rich in polyphenols, phytochemicals that are beneficial for cardiovascular health. Phenolic compounds have poor bioavailability but they are extensively metabolized by the gut microbiota. Therefore, we aimed to assess the association of microbial phenolic metabolites (MPM) with adherence to the MedDiet, and their relationship with ideal cardiovascular health (ICVH) and cardiovascular risk factors. **Methods and Results:** This cross-sectional sub study within the PREDIMED trial included 200 participants from the Barcelona-Clinic recruitment center. Five MPM were identified and quantified using a novel method based on liquid chromatography coupled to mass spectrometry: protocatechuic acid (PCA), enterodiol glucuronide (EDG), enterolactone glucuronide (ELG), vanillic acid glucuronide (VAG) and urolithin B glucuronide (UBG). Multivariable-adjusted regressions were used to evaluate the associations between MPM and MedDiet adherence, ICVH score, biochemical parameters, and blood pressure. Additionally, an MPM score was calculated as the weighted sum of MedDiet adherence and ICVH and found to be directly associated. Among individual polyphenols, UBG was inversely associated with LDL-cholesterol. **Conclusions:** A score of urinary MPM was associated with higher adherence to the MedDiet and ICVH, and individual MPM were related to better cardiovascular health. These findings suggest that the MedDiet may affect gut microbiota, whose metabolites are linked with cardiovascular health.

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Live Microbe Data and How to Submit to the Global Branded Food Products Database

February 27, 2023

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March 23, 2023

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Diet-Microbiome Interactions in Older People: Effect on Inflammaging

May 18, 2023

Virtual Event

Speaker: Paul O'Toole, PhD, Professor of Microbial Genomics and Head of Microbiology, University College Cork; Principal Investigator, APC Microbiome Ireland

Details and registration forthcoming!

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