

October 2021

Nutrition Briefs



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Scientific Integrity

The Strategic Council for Research Excellence, Integrity and Trust.

Marcia McNutt, France A. Córdova, David B. Allison. *PNAS* October 12, 2021. 118 (41). doi.org/10.1073/pnas.2116647118. [Article link](#)

Significance: The new Strategic Council (SC) seeks to optimize the excellence and trustworthiness of research for the benefit of society, and is charged with advancing the overall health, quality and effectiveness of the research enterprise across all domains that fund, execute, disseminate and apply scientific work in the public interest.

We announce the creation of a new body within the National Academies of Sciences, Engineering, and Medicine called the Strategic Council for Research Excellence, Integrity, and Trust, charged with advancing the overall health, quality, and effectiveness of the research enterprise across all domains that fund, execute, disseminate, and apply scientific work in the public interest. By promoting the alignment of incentives and policies, adoption of standard tools, and implementation of proven methods, the Strategic Council seeks to optimize the excellence and trustworthiness of research for the benefit of society.

Protein

E Protein Interventions Augment the Effect of Resistance Exercise on Appendicular Lean Mass and Handgrip Strength in Older Adults: A Systematic Review and Meta-analysis of Randomized Controlled Trials.

Richard P Kirwan, Mohsen Mazidi, Carmen Rodríguez García, Katie E Lane, Alireza Jafari, Tom Butler, Fatima Perez de Heredia, Ian G Davies. *The American Journal of Clinical Nutrition*, 21 October. doi.org/10.1093/ajcn/



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Significance: A Systematic Review and Meta-Analysis finds that in older adults, increasing protein alone had no benefit, but in combination with resistance exercise, improvement was observed in total LBM, ALM or HG.

Background: Increased protein intake is suggested as a strategy to slow or reverse the loss of muscle mass and strength observed in sarcopenia but results from studies that directly tested this possibility have been inconsistent. **Objectives:** We assessed the evidence on the effects of whole protein supplementation or higher-protein diets, without the use of amino acids or supplements known to stimulate hypertrophy, alone or in combination with resistance exercise (RE) interventions, on lean body mass (LBM) and strength in older adults. **Design:** A systematic search was conducted using PubMed, Medline, Web of Science and Cochrane CENTRAL databases from January 1990 up to July 2021. Randomized controlled trials that assessed the effects of protein supplementation and/or higher-protein dietary interventions in older adults (mean age ≥ 50 years), on total LBM, appendicular lean mass (ALM), handgrip (HG) and knee extension strength (KE) were included. **Results:** 28 studies were identified. In pooled analysis, compared with lower protein controls, protein supplementation did not have a significant positive effect on total LBM [weighted mean difference in change (WMD):0.34, 95% CI: $-0.21, 0.89$, I₂:90.01%], ALM [WMD:0.4, 95% CI: $-0.01, 0.81$, I₂:90.38%], HG [WMD:0.69, 95% CI: $-0.69, 2.06$, I₂:94.52%] or KE [WMD:1.88, 95% CI: $-0.6, 4.35$, I₂:95.35%]. However, in interventions that used also RE, statistically significant positive effects of protein were observed for ALM [WMD:0.54, 95% CI: $0.03, 1.05$, I₂:89.76%] and HG [WMD:1.71, 95% CI: $0.12, 3.30$, I₂:88.71%]. Meta-regression revealed no significant association between age, per-meal protein dose, duration, and baseline protein intake with change in any outcome. Sub-group analysis revealed the statistically significant effects on ALM only occurred in sarcopenic/frail populations (WMD:0.88, 95% CI: $0.51, 1.25$, I₂:79.0%). Most studies (n = 22) had some risk of bias. **Conclusions:** In older adults performing RE, increased protein intake leads to greater ALM and HG, compared with lower protein controls. Without RE, protein has no additional benefit on changes in total LBM, ALM or HG.

Lipids

Long-term Fasting Improves Lipoprotein-associated Atherogenic Risk in Humans.

Franziska Grundler, Dietmar Plonné, Robin Mesnage, Diethard Müller, Cesare R Sirtori, Massimiliano Ruscica, Françoise Wilhelmi de Toledo. *Eur J Nutr.* 2021 Oct;60(7):4031-4044. doi: 10.1007/s00394-021-02578-0.

[Article link](#)

Significance: Long-term fasting may improve lipoprotein levels and ameliorate the lipoprotein-associated atherogenic risk profile.

Purpose: Dyslipidemia is a major health concern associated with an increased risk of cardiovascular mortality. Long-term fasting (LF) has been shown to improve plasma lipid profile. We performed an in-depth investigation of lipoprotein composition. **Methods:** This observational study included 40 volunteers (50% men, aged 32-65 years), who underwent a medically supervised fast of 14 days (250 kcal/day). Changes in lipid and lipoprotein levels, as well as in lipoprotein subclasses and particles, were measured by ultracentrifugation and nuclear magnetic resonance (NMR) at baseline, and after 7 and 14 fasting days. **Results:** The largest changes were found after 14 fasting days. There were significant reductions in triglycerides (TG, -0.35 ± 0.1 mmol/L), very low-density lipoprotein (VLDL)-TG (-0.46 ± 0.08 mmol/L), VLDL-cholesterol (VLDL-C, -0.16 ± 0.03 mmol/L) and low-density lipoprotein (LDL)-C (-0.72 ± 0.14 mmol/L). Analysis of LDL subclasses showed a significant decrease in LDL1-C (-0.16 ± 0.05 mmol/L), LDL2-C (-0.30 ± 0.06 mmol/L) and LDL3-C (-0.27 ± 0.05 mmol/L). NMR spectroscopy showed a significant reduction in large VLDL particles (-5.18 ± 1.26 nmol/L), as well as large (-244.13 ± 39.45 nmol/L) and small LDL particles (-38.45 ± 44.04 nmol/L). A significant decrease in high-density lipoprotein (HDL)-C (-0.16 ± 0.04 mmol/L) was observed. By contrast, the concentration in large HDL particles was significantly raised. Apolipoprotein A1 decreased significantly whereas apolipoprotein B, lipoprotein(a), fibrinogen and high-sensitivity C-reactive protein were unchanged. **Conclusion:** Our results suggest that LF improves lipoprotein levels and lipoprotein subclasses and ameliorates the lipoprotein-associated atherogenic risk profile, suggesting a reduction in the cardiovascular risk linked to dyslipidemia.

Carbohydrates

Pasta Structure Affects Mastication, Belus Properties, and Postprandial Glucose and Insulin Metabolism in Healthy Adults, Saara

Saara Vanhatalo, Margherita Dall'Asta, Marta Cossu, Laura Chiavaroli, Veronica Francinelli, Giuseppe Di Pedè,

Significance: In healthy subjects, slowing starch hydrolysis by maintaining larger molecules and structural integrity during mastication and gastric digestion helps to lower postprandial glycemia explaining why pasta structure is more beneficial compared to other products prepared from similar durum wheat semolina flour.

Background: Structure and protein-starch interactions in pasta products may be responsible for lower postprandial glycemic responses compared with other cereal foods. **Objective:** We tested the effect on postprandial glucose metabolism induced by two pasta products, couscous, and bread, through their structural changes during mastication and simulated gastric digestion. **Methods:** Two randomized controlled trials (n = 30/trial) in healthy normal weight adults (23.9 and 23.0 kg/m²) evaluated postprandial glucose metabolism modulation to 50g of available carbohydrate portions of durum wheat semolina spaghetti, penne, couscous, and bread. A mastication trial involving 26 normal weight adults was conducted to investigate mastication processes and changes in particle size distribution and microstructure (light microscopy) of boluses after mastication and in vitro gastric digestion. **Results:** Both pasta products resulted in lower areas under the 2h-curve for blood glucose (-40% for spaghetti and -22% for penne vs couscous; -41% for spaghetti and -30% for penne vs bread), compared with the other grain products (P < 0.05). Pasta products required more chews (spaghetti: 34 ± 18; penne: 38 ± 20; bread: 27 ± 13; couscous: 24 ± 17) and longer oral processing (spaghetti: 21 ± 13 s; penne: 23 ± 14 s; bread: 18 ± 9 s; couscous: 14 ± 10 s) than bread or couscous (P < 0.01). Pastas contained more large particles (46–67% of total particle area) compared to bread (0–30%) and couscous (1%) after mastication and in vitro gastric digestion. After in vitro gastric digestion, pasta samples still contained large areas of non-hydrolyzed starch embedded within the protein network, protein in bread and couscous was almost entirely digested, and starch was hydrolyzed. **Conclusions:** Preservation of the pasta structure during mastication and gastric digestion explains slower starch hydrolysis and, consequently, lower postprandial glycemia compared to bread or couscous prepared from the same durum wheat semolina flour in healthy adults.

Low- and No-Calorie Sweeteners

Bioproduction of D-allulose: Properties, Applications, Purification and Future Perspectives.

Mengying Hu, Mengli Li, Bo Jiang, Tao Zhang. *Compr Rev Food Sci Food Saf*. 2021 Oct 19. doi: 10.1111/1541-4337.12859 [Article link](#)

Significance: D-allulose, an epimer of D-Fructose, can be biosynthesized and made safe for human consumption as recognized by the U.S. FDA. It also modulates several physiological processes.

D-allulose is the C-3 epimer of D-fructose, which rarely exists in nature, and can be biosynthesized from D-fructose by the catalysis of D-psicose 3-epimerase. D-allulose is safe for human consumption and was recently approved by the United States Food and Drug Administration for food applications. It is not only able to be used in food and dietary supplements as a low-calorie sweetener, but also modulates a variety of physiological functions. D-allulose has gained increasing attention owing to its excellent properties. This article presents a review of recent progress on the properties, applications, and bioproduction progress of D-allulose.

Cognitive Health

Association of Dietary Patterns with Cognitive Function and Cognitive Decline in Sydney Memory and Ageing Study: A Longitudinal Analysis.

Xi Chen, Zhixin Liu, Perminder S Sachdev, Nicole A Kochan, Fiona O'Leary, Henry Brodaty. *J Acad Nutr Diet*. 2021 Oct 21;S2212-2672(21)01425-8. doi: 10.1016/j.jand.2021.10.018. [Article link](#)

Significance: Increased intakes of nuts and legumes may slow cognitive decline, and link to better overall performance in global cognition and multiple cognitive domains. In contrast, no associations of Mediterranean or DASH dietary scores with overall cognition and cognitive decline over six years were observed.

Background: The relationship of dietary patterns to cognitive health in older adults has attracted much research attention. However, results from existing studies are inconclusive. **Objective:** The aim of this study was to investigate the association between dietary patterns and overall cognitive performance and cognitive change over time. **Design:** This analysis was conducted as part of the longitudinal Sydney Memory and Ageing study with six years follow up. Mediterranean diet and Dietary Approaches to Stop Hypertension (DASH) diet scores were generated based on dietary intake for each individual, assessed by the Dietary Questionnaire for Epidemiological Studies Version 2. **Setting:** This longitudinal study comprised 1037 community dwelling non-demented participants aged 70-90 years at baseline (September 2005 to December 2007), recruited from Sydney, Australia. Main outcome measures:

Neuropsychological tests assessed global cognition and 6 cognitive domains on four occasions, at baseline and 2, 4 and 6 years later. Statistical analyses performed: Linear mixed model analyses were conducted to examine the relationship between dietary scores, food components and overall cognitive function and cognitive change over six years. **Results:** No associations of Mediterranean or DASH dietary scores with overall cognition and cognitive decline over six years were found. Higher intake of legumes and nuts was related to better overall performance in global cognition ($\beta=0.091$; 95% CI: 0.035, 0.146; $P=0.001$) and to multiple cognitive domains, and to less decline in global cognition ($\beta=-0.016$; 95% CI: -0.032, -0.001; $P=0.032$). **Conclusion:** Study findings suggest that greater consumption of legumes and nuts maybe important to slow cognitive decline with age.

Sodium

A Low-Sodium DASH Dietary Pattern Affects Serum Markers of Inflammation and Mineral Metabolism in Adults with Elevated Blood Pressure

Valerie K Sullivan, Lawrence J Appel, Jesse C Seegmiller, Scott T McClure, Casey M Rebholz. *The Journal of Nutrition*, Vol. 151, Issue 10, October 2021, Pages 3067–3074, doi.org/10.1093/jn/nxab236. [Article link](#)

Significance: Contrary to hypothesis, biomarkers of inflammation were increased or unchanged by a low-sodium DASH diet compared with a high-sodium control diet in adults with elevated blood pressure. Further research to understand mechanisms may be warranted.

Background: The blood pressure–lowering effects of the Dietary Approaches to Stop Hypertension (DASH) dietary pattern and reduced sodium intake are well established. The effects on other biomarkers related to vascular health are of interest and might assist in explaining the effects of the DASH diet and sodium reduction. **Objectives:** We hypothesized that a low-sodium DASH diet improves (lowers) biomarkers of inflammation [C-reactive protein (CRP) and soluble urokinase plasminogen activator receptor (suPAR)] and mineral metabolism [phosphorus and fibroblast growth factor-23 (FGF23)]. **Methods:** We conducted a secondary analysis of the DASH-Sodium trial using frozen serum samples. This controlled feeding study randomly assigned 412 adults (≥ 22 y) with elevated blood pressure (120–159/80–95 mmHg) to consume either a DASH diet or control diet. Within each arm, participants received 3 sodium levels [low (1150 mg), intermediate (2300 mg), high (3450 mg)] in random sequence, each for 30 d. To maximize contrast, samples collected at the end of the low-sodium DASH ($n = 198$) and high-sodium control ($n = 194$) diets were compared. Between-diet differences in serum CRP, suPAR, phosphorus, and FGF23 concentrations were assessed using linear regression adjusted for age, sex, race, income, education, smoking status, and BMI. **Results:** CRP concentrations did not differ between groups ($P = 0.83$), but suPAR was higher after the low-sodium DASH diet than the high-sodium control [geometric mean 2470 pg/mL (95% CI: 2380, 2560 pg/mL), compared with 2290 pg/mL (95% CI: 2210, 2380 pg/mL); $P = 0.006$]. Phosphorus was higher after the low-sodium DASH diet [geometric mean 3.50 mg/dL (95% CI: 3.43, 3.57 mg/dL)] compared with the high-sodium control diet [geometric mean 3.39 mg/dL (95% CI: 3.33, 3.46 mg/dL); $P = 0.04$]. FGF23 was also higher after the low-sodium DASH diet [geometric mean 35.3 pg/mL (95% CI: 33.3, 37.3 pg/mL) compared with 28.2 pg/mL (95% CI: 26.6, 29.8 pg/mL); $P < 0.001$]. **Conclusions:** Contrary to our hypothesis, biomarkers of inflammation and mineral metabolism were increased or unchanged by a low-sodium DASH diet compared with a high-sodium control diet in adults with elevated blood pressure.

Gut Microbiome

Vitamin B-12 and the Gastrointestinal Microbiome: A Systematic Review.

Heather M Guetterman, Samantha L Huey, Rob Knight, Allison M Fox, Saurabh Mehta, Julia L Finkelstein. *Advances in Nutrition*, 06 October 2021, doi.org/10.1093/advances/nmab123. [Article link](#)

Significance: The impact of B12 on gut microbiome needs further research including prospective observational studies and RCTs. Current evidence suggests vitamin B-12 may be associated with changes in bacterial abundance but outcomes may depend on study types and forms of cobalamin used in the study.

Vitamin B-12 deficiency is a major public health problem affecting individuals across the lifespan, with known hematological, neurological, and obstetric consequences. Emerging evidence suggests that vitamin B-12 may have an important role in other aspects of human health, including the composition and function of the gastrointestinal (gut) microbiome. Vitamin B-12 is synthesized and utilized by bacteria in the human gut microbiome and is required for over a dozen enzymes in bacteria, compared to only two in humans. However, the impact of vitamin B-12 on the gut microbiome has not been established. This systematic review was conducted to examine the evidence that links vitamin B-12 and the gut microbiome. A structured search strategy was used to identify in vitro, animal, and human studies that assessed vitamin B-12 status, dietary intake, or supplementation, and

studies and no randomized trials have been conducted to examine the effects of vitamin B-12 on the human gut microbiome. The impact of vitamin B-12 on the gut microbiome needs to be elucidated to inform screening and public health interventions.

Biomarkers

The Influence of Nutrigenetics on Biomarkers of Selenium Nutritional Status.

Janaina L S Donadio, Graziela B S Duarte, Patrick Borel, Silvia M F Cozzolino, Marcelo M Rogero. *Nutrition Reviews*, Vol. 79, Issue 11, October 2021, Pages 1259–1273, doi.org/10.1093/nutrit/nuaa136. [Article link](#)

Significance: Nutrigenetic studies have identified single nucleotide polymorphisms in seleno-proteins that may clarify the high variability in reported values for biomarkers of Se nutritional status in different populations.

Selenium (Se) is an essential micronutrient for human biology that executes its functions as the amino acid selenocysteine via selenoproteins, which have important functions in, for example, antioxidation, immunomodulation, thyroid metabolism, and human fertility. Se nutritional status is assessed using the quantification of blood Se biomarkers, which are influenced by several factors, including diet, age, gender, smoking status, alcohol consumption, health condition, and the genetic characteristics of individuals. Nutrigenetic studies have identified single nucleotide polymorphisms in selenoproteins that might clarify the high variability in values reported for biomarkers of Se nutritional status in different populations, and the response of these biomarkers to Se supplementation with either organic or inorganic forms of Se. This review aims to (1) define the basic aspects of Se biology, (2) describe the current most commonly used biomarkers of Se nutritional status, and (3) provide a summary of associations between functional single nucleotide polymorphisms in selenoproteins and biomarkers of Se status in healthy populations.

Energy Balance

Commercial Devices Provide Estimates of Energy Balance with Varying Degrees of Validity in Free-Living Adults.

Robin P Shook, Hung-Wen Yeh, Gregory J Welk, Ann M Davis, Daniel Ries. *J. Nutrition* 2021 Oct 12. doi: 10.1093/jn/nxab317. [Article link](#)

Significance: Interest in improving accuracy, replacing self-reports with passive tools when estimating energy balance (EB) using intake (EI), storage (ES) and expenditure (EE) has led to wide use of commercial devices e.g. Fitbits. A study with free living adults looked at repeatability, and measurement error of these devices and showed varying degrees of validity when used to estimate EB compared to gold-standard techniques, with EE measures being the most robust and ES the poorest.



This work was supported by the IAFNS

Background: The challenges of accurate estimation of energy intake (EI) are well-documented, with self-reported values 12%-20% below expected values. New approaches rely on gold-standard assessments of the other components of energy balance, energy expenditure (EE) and energy storage (ES), to estimate EI. **Objectives:** The purpose of this study was to evaluate the validity, repeatability, and measurement error of consumer devices when estimating energy balance in a free-living population. **Methods:** Twenty-four healthy adults (14 women, 10 men; mean \pm SD age: 30.7 \pm 8.2 y) completed two 14-d assessment periods, including assessments of EE and ES using gold-standard [doubly labeled water (DLW) and DXA] and commercial devices [Fitbit Alta HR activity monitor (Alta) and Fitbit Aria wireless body composition scale (Aria)], and of EI by dietician-administered recalls. Accuracy and validity were assessed using Spearman correlation, interclass correlation, mean absolute percentage error, and equivalency testing. We also applied linear measurement error modeling including error in gold-standard devices and within-subject repeated-measures design to calibrate consumer devices and quantify error. **Results:** There was moderate to strong agreement for EE between the Fitbit Alta and DLW at each time point ($r_s = 0.82$ and 0.66 for Times 1 and 2, respectively). There was weak agreement for ES between the Fitbit Aria and DXA ($r_s = 0.15$ and 0.49 for Times 1 and 2, respectively).

Correlations between methods to assess EI ranged from weak to strong, with agreement between the DXA/DLW-calculated EI and dietary recalls being the highest ($r_s = 0.63$ for Time 1 and 0.73 for Time 2). Only EE from the Fitbit Alta at Time 1 was equivalent to the DLW value using equivalency testing. **Conclusions:** Commercial devices provide estimates of energy balance in free-living adults with varying degrees of validity compared to gold-standard techniques. EE estimates were the most robust overall, whereas ES estimates were poor.