Dietary Patterns

A Randomized Controlled-Feeding Trial Based on the Dietary Guidelines for Americans on Cardiometabolic Health Indexes


Significance: This is the first randomized, controlled intervention trial to demonstrate that relative to a typical American diet, a diet pattern based on the Dietary Guidelines for Americans reduces systolic blood pressure, but not other measures of glucose homeostasis or fasting lipids, in overweight and obese women.

Background: The 2010 Dietary Guidelines for Americans (DGA) recommend nutrient needs be met by increasing fruit, vegetable, and whole-grain intake with the use of low-fat or fat-free dairy products and by reducing sodium, solid fats, and added sugars. However, the DGA, as a dietary pattern, have not been tested in an intervention trial. Objective: The aim of this study was to evaluate the impact of a DGA-based diet compared with a representative typical American diet (TAD) on glucose homeostasis and fasting lipids in individuals at risk of cardiometabolic disease. Design: A randomized, double-blind, controlled 8-wk intervention was conducted in overweight and obese women selected according to indexes of insulin resistance or dyslipidemia. Women were randomly assigned to the DGA or TAD group (n = 28 DGA and 24 TAD). The TAD diet was based on average adult intake from the NHANES 2009-2010. The DGA and TAD diets had respective Healthy Eating Index scores of 98 and 62. All foods and beverages were provided during the intervention. Oral-glucose tolerance and fasting lipids were evaluated at 0, 2, and 8 wk of the intervention. Insulin resistance and sensitivity were estimated with the use of surrogates (e.g., homeostasis model assessment of insulin resistance). Results: By design, volunteers maintained their weight during the intervention. Fasting insulin, glucose, triglycerides, oral-glucose tolerance, and indexes of insulin resistance were not affected by either of the diets. Systolic blood pressure decreased in the DGA group (~-9 mm Hg; P < 0.05). Total and HDL cholesterol also decreased in both groups (P < 0.05). Exploratory analysis comparing volunteers entering the study with insulin resistance and dyslipidemia with those with only dyslipidemia did not show an effect of pre-existing conditions on glucose tolerance or fasting lipid outcomes. Conclusions: The consumption of a DGA dietary pattern for 8 wk without weight loss reduced systolic blood pressure. There were no differences between the DGA and TAD diets in fasting insulin, glucose, indexes of insulin resistance, or fasting lipids. This trial was registered at www.clinicaltrials.gov as NCT02298725.

Development of the Food-Based Lifelines Diet Score (LLDS) and its Application in 129,369 Lifelines Participants


Significance: The Lifelines Diet Score is based on the latest evidence for diet-disease relationship and can be used as a flexible tool for diet quality assessment.

Background/Objectives: Many diet quality scores exist, but fully food-based scores based on contemporary evidence are scarce. Our aim was to develop a food-based diet score based on international literature and examine its discriminative capacity and socio-demographic determinants. Subjects/Methods: Between 2006 and 2013, dietary intake of 129,369 participants of the Lifelines Cohort (42% male, 45 ± 13 years (range 18-93)) was assessed with a 110-item food frequency questionnaire. Based on the 2015 Dutch Dietary Guidelines and underlying literature, nine food groups with positive (vegetables, fruit, whole grain products, legumes & nuts, fish, oils & soft margarines, unsweetened dairy, coffee and tea) and three food groups with negative health effects (red & processed meat, butter & hard margarines and sugar-sweetened beverages) were identified. Per food group, the intake in grams

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per 1000 kcal was categorized into quintiles, awarded 0 to 4 points (negative groups scored inversely) and summed. Food groups with neutral, unknown or inconclusive evidence are described but not included. Results: The Lifelines Diet Score (LLDS) discriminated well between high and low consumers of included food groups. This is illustrated by e.g. a 2-fold higher vegetable intake in the highest, compared to the lowest LLDS quintile. Differences were 5.5-fold for fruit, 3.5-fold for fish, 3-fold for dairy and 8-fold for sugar-sweetened beverages. The LLDS was higher in females and positively associated with age and educational level. Conclusions: The LLDS is based on the latest international evidence for diet-disease relations at the food group level and has high capacity to discriminate people with widely different intakes. Together with the population-based quintile approach, this makes the LLDS a flexible, widely applicable tool for diet quality assessment.

Serum Untargeted Metabolomic Profile of the Dietary Approaches to Stop Hypertension (DASH) Dietary Pattern

Significance: An array of serum metabolites was identified that is associated with adherence to the DASH diet, allowing for objective measurement of dietary pattern adherence.

Background: The Dietary Approaches to Stop Hypertension (DASH) dietary pattern is recommended for cardiovascular disease risk reduction. Assessment of dietary intake has been limited to subjective measures and a few biomarkers from 24-h urine collections. Objective: The aim of the study was to use metabolomics to identify serum compounds that are associated with adherence to the DASH dietary pattern. Design: We conducted untargeted metabolomic profiling in serum specimens collected at the end of 8 wk following the DASH diet (n = 110), the fruit and vegetables diet (n = 111), or a control diet (n = 108) in a multicenter, randomized clinical feeding study (n = 329). Multivariable linear regression was used to determine the associations between the randomized diets and individual log-transformed metabolites after adjustment for age, sex, race, education, body mass index, and hypertension. Partial least-squares discriminant analysis (PLS-DA) was used to identify a panel of compounds that discriminated between the dietary patterns. The area under the curve (C statistic) was calculated as the cumulative ability to distinguish between dietary patterns. We accounted for multiple comparisons with the use of the Bonferroni method (0.05 of 818 metabolites = 6.11 × 10⁻⁵). Results: Serum concentrations of 44 known metabolites differed significantly between participants randomly assigned to the DASH diet compared with both the control diet and the fruit and vegetables diet, which included an amino acid, 2 cofactors and vitamins (n = 2), and lipids (n = 41). With the use of PLS-DA, component 1 explained 29.4% of the variance and component 2 explained 12.6% of the variance. The 10 most influential metabolites for discriminating between the DASH and control dietary patterns were N-methylproline, stachydrine, tryptophan betaine, theobromine, 7-methylurate, chiro-inositol, 3-methylxanthine, methyl glucopyranoside, β-cryptoxanthin, and 7-methylxanthine (C statistic = 0.986). Conclusions: An untargeted metabolomic platform identified a broad array of serum metabolites that differed between the DASH diet and 2 other dietary patterns. This newly identified metabolite panel may be used to assess adherence to the DASH dietary pattern. This trial was registered at http://www.clinicaltrials.gov as NCT03403166.

Perspective: Food-Based Dietary Guidelines in Europe-Scientific Concepts, Current Status, and Perspectives

Significance: This review of European food-based dietary guidelines identifies aspects that will be important to consider during the development of future dietary guidance.

The Food-based dietary guidelines (FBDGs) are important tools for nutrition policies and public health. FBDGs provide guidelines on healthy food consumption and are based on scientific evidence. In the past, disease prevention and nutrient recommendations dominated the process of establishing FBDGs. However, scientific advances and social developments such as changing lifestyles, interest in personalized health, and concerns about sustainability require a reorientation of the creation of FBDGs to include a wider range of aspects of dietary behavior. The present review evaluates current European FBDGs with regard to the concepts and aspects used in their derivation, and summarizes the major aspects currently discussed to be considered in future establishment or updates of FBDGs. We identified English information on official European FBDGs through an Internet search (FAO, PubMed, Google) and analyzed the aspects used for their derivation. Furthermore, we searched literature databases (PubMed, Google Scholar) for conceptional considerations dealing with FBDGs. A total of 34 out of 53 European countries were identified as having official FBDGs, and for 15 of these, documents with information on the scientific basis could be identified and described. Subsequently, aspects underlying the derivation of current FBDGs and aspects considered in the literature as important for future FBDGs were discussed. Eight aspects were identified: diet-health relations, nutrient supply, energy supply, dietary habits, sustainability, food-borne contaminants, target group segmentation, and individualization. The first 4 have already been widely applied in existing FBDGs; the others have almost never been taken into account. It remains a future challenge to re(conceptualize the development of FBDGs, to operationalize the aspects to be incorporated in their derivation, and to convert concepts into systematic approaches. The current review may assist national expert groups and clarifies the options for future development of local FBDGs.
Nutrition Research Design

Perspective: Fundamental Limitations of the Randomized Controlled Trial Method in Nutritional Research: The Example of Probiotics

Significance: The limitations of the randomized controlled trial are discussed in the context of nutritional research.

Dietary Studies on the relation between health and nutrition are often inconclusive. There are concerns about the validity of many research findings, and methods that can deliver high-quality evidence—such as the randomized controlled trial (RCT) method—have been embraced by nutritional researchers. Unfortunately, many nutritional RCTs also yield ambiguous results. It has been argued that RCTs are ill-suited for certain settings, including nutritional research. In this perspective, we investigate whether there are fundamental limitations of the RCT method in nutritional research. To this end, and to limit the scope, we use probiotic studies as an example. We use an epistemological approach and evaluate the presuppositions that underlie the RCT method. Three general presuppositions are identified and discussed. We evaluate whether these presuppositions can be considered true in probiotic RCTs, which appears not always to be the case. This perspective concludes by exploring several alternative study methods that may be considered for future probiotic or nutritional intervention trials.

Protein

Rate of Appearance of Amino Acids After a Meal Regulates Insulin and Glucagon Secretion in Patients with Type 2 Diabetes: A Randomized Clinical Trial

Significance: Proteins from pea and casein exhibited differing glucagon and insulinotropic effects in patients with type 2 diabetes, suggesting that protein from specific sources may be used to enhance glycemic control.

Background: Meal composition regulates the postprandial response of pancreatic and gastrointestinal hormones and plays an important role in patients with type 2 diabetes (T2D). Proteins have glucagon and insulinotropic effects, which may differ depending on amino acid composition, form of intake, and rate of digestibility and absorption. Objective: The aim of this study was to test effects of isolated pea protein-based (PP) compared with casein protein-based (CP) meals differing in amino acid compositions on endocrine responses to meal tolerance tests (MTTs) in patients with T2D. Design: Thirty-seven individuals with T2D [mean ± SD age: 64 ± 6 y; mean ± SD body mass index (kg/m2): 30.2 ± 3.6; mean ± SD glycated hemoglobin: 7.0% ± 0.6%] were randomly assigned to receive either high-animal-protein (~80% of total protein) or high-plant-protein (~72% of total protein) diets (30% of energy from protein, 40% of energy from carbohydrate, 30% of energy from fat) for 6 wk. MTTs were performed at study onset and after 6 wk. Participants received standardized high-protein (30% of energy) meals 2 times/d containing either CP-rich (~85% wt:wt) or PP-rich (~95% wt:wt) foods. Results: The CP and PP meals produced differences in insulin, C-peptide, glucagon, and glucose-dependent insulinotropic peptide (GIP) release. Total areas under the curve after CP were significantly lower than after the PP lunch by 40% for insulin and 23% for glucagon. Indexes of insulin sensitivity and secretion were significantly improved for the second CP MTT. This was accompanied by differential rates of appearance of amino acids. The ingestion of PP resulted in significant increases in amino acids after both meals, with a decline between meals. By contrast, CP intake resulted in increases in most amino acids after breakfast, which remained elevated but did not increase further after lunch. Conclusions: PP elicits greater postprandial increases in glucagon than does CP and consequently requires higher insulin to control glucose metabolism, which appears to be related to the rate of amino acid appearance. The metabolic impact of protein quality could be used as a strategy to lower insulin needs in patients with T2D. This trial was registered at www.clinicaltrials.gov as NCT02402985.

Carbohydrates

Are Heterozygous Carriers for Hereditary Fructose Intolerance Predisposed to Metabolic Disturbances when Exposed to Fructose?

Significance: Heterozygous carriers for hereditary fructose intolerance exhibit a postprandial increase in plasma uric acid concentrations.
Bioactives

Dietary Flavonoids and the Prevalence and 15-y Incidence of Age-Related Macular Degeneration


Significance: This population-based cohort study found an inverse relationship between dietary flavonoid intake and risk of age-related macular degeneration.

Sodium

Predictors for Misreporting Sodium and Potassium Intakes by Overweight and Obese Participants in a Food-Based Clinical Trial: Implications for Practice


Significance: Predictors for the difference between self-reported values and urinary biomarkers of sodium and potassium intake are presented.

This study compared self-reported sodium and potassium intakes with urinary biomarkers and identified predictive factors. Secondary analysis of the 3-month intensive phase of the HealthTrack study with control (C), interdisciplinary intervention (I), intervention plus 30 g walnuts/day (IW) arms (n = 149). Dietary data was derived from diet history (DH) interviews and biomarker...
measures from urine. Urine-derived sodium (all, p = 0.000) and potassium (C: p = 0.011; I: p = 0.000; IW: p = 0.004) measures were significantly greater than self-reported intakes over the three months. Multiple linear regression showed body weight at baseline, body mass index (BMI) at baseline, and combined BMI at baseline and DH interviewer significantly negatively predicted the differences in sodium intake and excretion for C (β = -21.226, p = 0.016), I (β = -106.140, p = 0.002) and IW (F (9.530, 2df), p = 0.000), respectively. Where intakes of sodium and potassium are of interest in a trial, both reported and urine-derived values for sodium and potassium are recommended.

Spot Urine and 24-h Diet Recall Estimates of Dietary Sodium Intake from the 2008/09 New Zealand Adult Nutrition Survey: A Comparison

Significance: A significant difference exists between 24-hour dietary recall and estimated urinary excretion for sodium intake.

Background: We aimed to test the difference between estimates of dietary sodium intake using 24-h diet recall and spot urine collection in a large sample of New Zealand adults. Methods: We analysed spot urine results, 24-h diet recall, dietary habits questionnaire and anthropometry from a representative sample of 3312 adults aged 15 years and older who participated in the 2008/09 New Zealand Adult Nutrition Survey. Estimates of adult population sodium intake were derived from 24-h diet recall and spot urine sodium using a formula derived from analysis of INTERSALT data. Correlations, limits of agreement and mean difference were calculated for the total sample, and for population subgroups. Results: Estimated total population 24-h urinary sodium excretion (mean (95% CI)) from spot urine samples was 3035 mg (2990, 3079); 3612 mg (3549, 3674) for men and 2507 mg (2466, 2548) for women. Estimated mean usual daily sodium intake from 24-h diet recall data (excluding salt added at the table) was 2564 mg (2519, 2608); 2849 mg (2779, 2920) for men and 2304 mg (2258, 2350) for women. Correlations between estimates were poor, especially for men, and limits of agreement using Bland-Altman mean difference analysis were wide. Conclusions: There is a poor agreement between estimates of individual sodium intake from spot urine collection and those from 24-hour diet recall. Although, both 24-hour dietary recall and estimated urinary excretion based on spot urine indicate mean population sodium intake is greater than 2 g, significant differences in mean intake by method deserve further investigation in relation to the gold standard, 24-hour urinary sodium excretion.

Micronutrients

Dietary Calcium Intake and Hypertension Risk: A Dose-Response Meta-Analysis of Prospective Cohort Studies

Significance: This meta-analysis found an association between dietary calcium intake and risk of developing hypertension.

The association of calcium intake with risk of developing hypertension in the general population has not been established yet. We systematically searched PubMed and Scopus databases up to February 2018 to find prospective observational studies investigating the association of calcium intake with risk of developing hypertension. The reported risk estimates were pooled using a random-effects model. Eight prospective cohort studies (248,398 participants and 30,838 cases) were included. Seven studies measured dietary calcium intake, but one study measured total calcium intake (calcium from food and supplements). A significant inverse association was found for the highest versus lowest category of calcium intake (relative risk: 0.89, 95%CI: 0.86, 0.93; I² = 0%, n = 8), and for each 500 mg/d increment (relative risk: 0.93, 95%CI: 0.90, 0.97; I² = 64%, n = 7). Summary results were the same with the main analyses when the analyses were restricted only to dietary calcium intake. A nonlinear dose-response meta-analysis exhibited a linear inverse association, with a somewhat steeper trend within the low and moderate intakes. In conclusion, higher dietary calcium intake, independent of adiposity and intake of other blood pressure-related minerals, is slightly associated with a lower risk of developing hypertension.

Lipids

Effect of High-Carbohydrate or High-Monounsaturated Fatty Acid Diets on Blood Pressure: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Significance: The optimal macronutrient profile in the context of a low-saturated fat diet for cardiovascular disease risk management is not yet known.
Context: Current dietary guidelines for cardiovascular disease risk management recommend restricting intake of saturated fatty acids (SFAs). However, the optimal macronutrient profile, in the context of a low-SFA diet, remains controversial. The blood-pressure effect of replacing SFAs in diets with monounsaturated fatty acids (MUFAs) compared with carbohydrate has not been quantified to date. Objective: To synthesize the evidence for the effect of substituting a high-carbohydrate (high-CHO) diet for a high-monounsaturated fatty acid (high-MUFA) diet on blood pressure, a systematic review and meta-analysis of randomized clinical trials in a population without health restrictions was conducted. Data Sources: MEDLINE, EMBASE, and Cochrane Central Register of Controlled Clinical Trials were searched through June 7, 2017. Randomized controlled trials of >3 weeks duration that assessed the effect of high-MUFA diets in isocaloric substitution for high-CHO diets on systolic blood pressure (SBP) and diastolic blood pressure (DBP) were included. Data Extraction: Data were pooled using the generic-inverse variance method with random effects models and expressed as mean differences (MDs) with 95% confidence intervals (CIs). Heterogeneity was assessed by Cochran Q statistic and quantified by the I² statistic. The quality of the evidence was assessed with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) system. Results: Fourteen trials (n = 980 participants) were included in the analysis. Comparatively, the high-MUFA diets in isocaloric substitution for high-CHO diets did not demonstrate a greater reduction in blood pressure (SBP: MD = -0.08 mmHg [95%CI, -1.01 to 0.84], P = 0.86; DBP: MD = 0.01 mmHg [95%CI, -0.73 to 0.75], P = 0.98). The overall quality of the evidence was assessed as moderate. Conclusions: In the context of low SFAs, high-MUFA diets in isocaloric substitution for high-CHO diets did not affect blood pressure in individuals with and without hypertension. Large-scale trials achieving higher MUFA targets are required to support these findings.

**Effects of n-3 Fatty Acid Supplements in Diabetes Mellitus**


**Significance:** Daily supplementation with omega-3 fatty acids did not reduce the risk of serious vascular events in patients with type 2 diabetes relative to placebo.

**Background:** Increased intake of n-3 fatty acids has been associated with a reduced risk of cardiovascular disease in observational studies, but this finding has not been confirmed in randomized trials. It remains unclear whether n-3 (also called omega-3) fatty acid supplementation has cardiovascular benefit in patients with diabetes mellitus. Methods: We randomly assigned 15,480 patients with diabetes but without evidence of atherosclerotic cardiovascular disease to receive 1-g capsules containing either n-3 fatty acids (fatty acid group) or matching placebo (olive oil) daily. The primary outcome was a first serious vascular event (i.e., nonfatal myocardial infarction or stroke, transient ischemic attack, or vascular death, excluding confirmed intracranial hemorrhage). The secondary outcome was a first serious vascular event or any arterial revascularization. Results: During a mean follow-up of 7.4 years (adherence rate, 76%), a serious vascular event occurred in 689 patients (8.9%) in the fatty acid group and in 712 (9.2%) in the placebo group (rate ratio, 0.97; 95% confidence interval [CI], 0.87 to 1.08; P = 0.55). The composite outcome of a serious vascular event or revascularization occurred in 882 patients (11.4%) and 887 patients (11.5%), respectively (rate ratio, 1.00; 95% CI, 0.91 to 1.09). Death from any cause occurred in 752 patients (9.7%) in the fatty acid group and in 788 (10.2%) in the placebo group (rate ratio, 0.95; 95% CI, 0.86 to 1.05). There were no significant between-group differences in the rates of nonfatal serious adverse events. Conclusions: Among patients with diabetes without evidence of cardiovascular disease, there was no significant difference in the risk of serious vascular events between those who were assigned to receive n-3 fatty acid supplementation and those who were assigned to receive placebo. (Funded by the British Heart Foundation and others; Current Controlled Trials number, ISRCTN60633500; ClinicalTrials.gov number, NCT00135226.)

**Progress and Perspectives in Plant Sterol and Plant Stanol Research**


**Significance:** This review found that long-term clinical trials investigating the effects of plant sterols and stanols on endpoints of cardiovascular disease are lacking. Current evidence indicates that foods with added plant sterols or stanols can lower serum levels of low-density lipoprotein cholesterol.

This review summarizes the recent findings and deliberations of 31 experts in the field who participated in a scientific meeting in Winnipeg, Canada, on the health effects of plant sterols and stanols. Participants discussed issues including, but not limited to, the health benefits of plant sterols and stanols beyond cholesterol lowering, the role of plant sterols and stanols as adjuncts to diet and drugs, and the challenges involved in measuring plant sterols and stanols in biological samples. Variations in interindividual responses to plant sterols and stanols, as well as the personalization of lipid-lowering therapies, were addressed. Finally, the clinical aspects and treatment of sitosterolemia were reviewed. Although plant sterols and stanols continue to offer an efficacious and convenient dietary approach to cholesterol management, long-term clinical trials investigating the endpoints of cardiovascular disease are still lacking.
**Microbiome**

**Prebiotic and Probiotic Treatment of Nonalcoholic Fatty Liver Disease: A Systematic Review and Meta-Analysis**


**Significance:** This systematic review and meta-analysis found supporting evidence for the use of microbial therapies in nonalcoholic fatty liver disease.

Context: Nonalcoholic fatty liver disease (NAFLD) is a highly prevalent and underdiagnosed comorbidity of many chronic diseases that is associated with altered intestinal bacterial communities. This association has prompted research into alternative treatments aimed at modulating intestinal microbiota. Given the novelty of these treatments, scarce evidence regarding their effectiveness in clinical populations exists. Objective: This meta-analysis sought to systemically review and quantitatively synthesize evidence on prebiotic, probiotic, and synbiotic therapies for patients with NAFLD in randomized controlled trials. Data Sources: PRISMA guidelines ensured transparent reporting of evidence. PICOS criteria defined the research question for the systematic review. A systematic keyword search in PubMed and EMBASE identified 25 studies: 9 assessed prebiotic, 11 assessed probiotic, and 7 assessed symbiotic therapies for a total of 1309 patients. Data Extraction: Basic population characteristics, the primary variables of aspartate aminotransferase (AST) and alanine aminotransferase (ALT) (utilized for NAFLD diagnosis), and the secondary variables of body mass index (BMI), gamma-glutamyl transferase (γ-GT), tumor necrosis factor alpha (TNF-α), C-reactive protein (CRP), total cholesterol, high-density lipoprotein cholesterol (HDL-c), low-density lipoprotein cholesterol (LDL-c), and triglycerides (TAG) were extracted. Pooled effect sizes of these variables were calculated by meta-analysis. No publication bias was identified using Begg’s and Egger’s tests or Cochrane bias assessment tool.

**Results:** Meta-analysis indicated that microbial therapies significantly reduced BMI (-0.37 kg/m²; 95% confidence interval [CI], -0.46 to -0.28; P < 0.001), hepatic enzymes (ALT, -6.9 U/L [95%CI, -9.4 to -4.3]; AST, -4.6 U/L [95%CI, -6.6 to -2.7]; γ-GT, -7.9 U/L [95%CI, -11.4 to -4.4]; P < 0.001), serum cholesterol (-10.1 mg/dL; 95%CI, -13.6 to -6.6; P < 0.001), LDL-c (-4.5 mg/dL; 95%CI, -8.9 to -0.17; P < 0.001), and TAG (-10.1 mg/dL; 95%CI, -18.0 to -2.3; P < 0.001), but not inflammation (TNF-α, -2.0 ng/mL [95%CI, -4.7 to 0.61]; CRP, -0.74 mg/L [95%CI, -1.9 to 0.37]). Subgroup analysis by treatment category indicated similar effects of prebiotics and probiotics on BMI and liver enzymes but not total cholesterol, HDL-c, and LDL-c.

**Conclusion:** This meta-analysis supports the potential use of microbial therapies in the treatment of NAFLD and sheds light on their potential mode of action. Further research into these treatments should consider the limitations of biomarkers currently used for the diagnosis and progression of NAFLD, in addition to the inherent challenges of personalized microbial-based therapies.

**Relationship Between Diet, the Gut Microbiota, and Brain Function**


**Significance:** This review highlights how external factors such as diet may influence gut microbial composition and ameliorate symptoms of physical and mental disorders.

The human intestinal microbiota, comprising trillions of microorganisms, exerts a substantial effect on the host. The microbiota plays essential roles in the function and development of several physiological processes, including those in the brain. A disruption in the microbial composition of the gut has been associated with many metabolic, inflammatory, neurodevelopmental, and neurodegenerative disorders. Nutrition is one of several key factors that shape the microbial composition during infancy and throughout life, thereby affecting brain structure and function. This review examines the effect of the gut microbiota on brain function. The ability of external factors, such as diet, to influence the microbial composition implies a certain vulnerability of the gut microbiota. However, it also offers a potential therapeutic strategy for ameliorating symptoms of mental and physical disorders.

Therefore, this review examines the potential effect of nutritional components on gut microbial composition and brain function.