FROM THE ACADEMY
Position Paper

Vegetarian Dietary Patterns for Adults: A Position Paper of the Academy of Nutrition and Dietetics

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ABSTRACT

It is the position of the Academy of Nutrition and Dietetics that, in adults, appropriately planned vegetarian and vegan dietary patterns can be nutritionally adequate and can offer long-term health benefits such as improving several health outcomes associated with cardiometabolic diseases. Vegetarian dietary patterns exclude meat, poultry, and seafood, and vegan dietary patterns exclude all foods of animal origin. Registered dietitian nutritionists (RDNs) and nutrition and dietetics technicians, registered (NDTRs) play a pivotal role in providing meal-planning strategies and evidence-based nutrition information to clients currently following vegetarian or vegan dietary patterns or who may benefit from and express interest in following vegetarian or vegan dietary patterns. RDNs and NDTRs can work with their clients to create tailored, lifestyle-oriented, nutritionally balanced, and culturally suitable vegetarian and vegan dietary patterns that optimize health benefits while reducing concerns about nutrient inadequacies. Adults follow vegetarian and vegan dietary patterns for various reasons. The aim of this Position Paper is to inform health care practitioners, including RDNs and NDTRs, about the evidence-based benefits and potential concerns of following vegetarian and vegan dietary patterns for different populations of nonpregnant, nonlactating adults. This Position Paper is supported by current evidence, including several systematic reviews. As leaders in evidence-based nutrition care, RDNs and NDTRs should aim to support the development and facilitation of vegetarian and vegan dietary patterns and access to nutrient-dense plant-based meals. Promoting a nutrient-balanced vegetarian dietary pattern on both individual and community scales may be an effective tool for preventing and managing many diet-related conditions. This Position was approved in January 2025 and will remain in effect until December 31, 2032.

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Supplementary materials:
Figure 4 are available at www.jandonline.org

VEGETARIAN, INCLUDING vegan, dietary patterns continue to be of interest for many people across different groups.[1] Major motivators of adopting vegetarian dietary patterns include a heightened awareness of health[2-5] and environmental benefits,[6-10] ethics surrounding animal treatment,[11-13] socioeconomic considerations,[14] and dietary guidance centered around various cultural and religious practices.[15] Lacto-ovo vegetarian dietary patterns exclude meat, poultry and fish, and vegan dietary patterns additionally exclude eggs, dairy, and all other animal-sourced foods and their by-products.[16] There is no standard definition of "plant-based" dietary patterns, but in this article, the term will refer to those dietary patterns in which foods of animal origin are mostly or completely excluded.[17] On a global scale, vegetarian dietary practices vary by country and are estimated to be of interest to approximately 15% of the population,[15] apart from India where 4 in 10 people consider themselves vegetarian.[18]

The 2020-2025 Dietary Guidelines for Americans recommend a healthy vegetarian-style dietary pattern, described as a lacto-ovo vegetarian dietary pattern, as 1 of 3 dietary options to promote health and prevent disease.[19] Plant-based dietary patterns have been endorsed by public health services organizations such as the World Cancer Research Fund/American Institute for Cancer Research, American Heart Association, American College of Cardiology, the American Diabetes Association Standard of Care in Diabetes, American College of Lifestyle Medicine, and American Cancer Society.[20-27]

Position Statement

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Vegetarian and vegan dietary patterns have been associated with both health benefits and concerns,[28] which can depend on the overall food variety and healthfulness of the specific food choices and dietary approach.[29,30] Registered dietitian nutritionists (RDNs) can provide evidence-based guidance and support for adults who may benefit from and express interest in or are currently following vegetarian/vegan dietary patterns by helping them choose higher quality plant-based foods and encouraging healthful eating habits that include skill development in food shopping, meal planning and preparation, and cooking. Contextual understanding of motivations, changing demographics, immigrant acculturative practices, and food innovations are critical as RDNs design and implement nutrition interventions with vegetarian and other plant-based dietary patterns. National polls indicate that nearly 6% of adults in the United States follow vegetarian and vegan diets,[1,31] highlighting the need for inclusivity and ongoing support from the dietetics community.

The objectives of this Position Paper are to inform RDNs, nutrition and dietetics technicians, registered (NDTRs), and other health care providers about:

- Evidence-based benefits and potential concerns of following vegetarian, including vegan, dietary patterns for different populations; and
- Strategies to facilitate healthy vegetarian/vegan dietary patterns in specific populations and settings.

This Position Paper addresses vegetarian dietary patterns in adults aged 18 years or older who are not pregnant or lactating. Facilitating vegetarian dietary patterns in individuals younger than age 18 years and/or for those pregnant or lactating requires specific guidance that considers how vegetarian dietary patterns may influence these crucial stages of growth and development and is outside the scope of this Position Paper. The target audience for this article is RDNs, NDTRs, and other health care practitioners.

POSITION PAPER PROCESS

At the Academy of Nutrition and Dietetics, Position Papers must be supported by high or moderate certainty evidence from a systematic review.[32] Expert panel members were selected by the Academy's Council on Research Workgroup Selection Subcommittee. Panel members and methodologists from the Academy's Evidence Analysis Center created research questions and eligibility criteria, and systematically identified and summarized the evidence using gold standard methods.[33,34] Existing systematic reviews were examined to determine the influence of vegetarian dietary patterns for adults in the general population.[28,35] Systematic reviews of randomized controlled trials were conducted to examine the effects of vegetarian dietary patterns for disease and risk factor management.[28,36]

Following the systematic review, expert panel members identified professional practice areas that may be controversial, confusing, or important to policy.[32] Topics identified included how to ensure diet quality and prevent nutrient deficiencies and how to facilitate vegetarian and vegan dietary patterns in specific populations and settings. This Position Paper underwent peer review by Academy of Nutrition and Dietetics (Academy) members and staff, and authors edited the manuscript accordingly. This Position Paper was approved by the Academy's Research Committee and Board of Directors.

SUMMARY OF EVIDENCE

The full systematic reviews supporting this Position Paper can be found in other peer reviewed publications[35,36] and on the Academy's Evidence Analysis Library website.[28] This section provides an overview of findings from these systematic reviews on vegetarian and vegan dietary patterns and health outcomes (Figure 1 and Figure 2, respectively).

Disease Prevention

Twenty-seven recent systematic reviews examined relationships between vegetarian dietary patterns and priority outcomes for presumably healthy adults in the general population. Studies that focused on the general population typically had observational study designs. Moderate quality evidence indicates that vegetarian, including vegan, dietary patterns are associated with reduced cardiovascular disease (CVD) incidence compared with nonvegetarian dietary patterns.[35] Low and very low quality evidence demonstrates several other potential benefits of following vegetarian and/or vegan dietary patterns, including reduced risk of CVD mortality and overall cancer incidence, reduced blood pressure, reduction in some blood lipid and C-reactive protein concentrations, and lower body mass index (BMI).[35] However, low and very low quality evidence also describes some potential concerns of following vegetarian and vegan dietary patterns for adults in the general population, including lower bone mineral density as well as increased risk of fractures and lower vitamin B12 and vitamin D concentrations for those following vegan dietary patterns.[28]

Disease Management

Systematic reviews of 27 randomized controlled trials describe effects of vegetarian dietary patterns in adults with CVD risk factors (n = 17), CVD (n = 3), and/or type 2 diabetes mellitus (T2DM) (n = 7). In adults with CVD risk factors, primarily overweight or obesity, moderate quality evidence demonstrates that vegetarian or vegan dietary patterns are likely to reduce BMI compared with therapeutic or nontherapeutic nonvegetarian dietary patterns. In addition, vegetarian dietary patterns may be equal in efficacy to therapeutic nonvegetarian dietary patterns in reducing fasting blood glucose concentrations (low quality evidence).[28]

In adults with T2DM, moderate quality evidence demonstrates vegetarian and vegan dietary patterns are likely to reduce hemoglobin A1c value and BMI compared with therapeutic or nontherapeutic nonvegetarian dietary patterns.[36] Although evidence was mixed, it does suggest a benefit of vegetarian dietary patterns on diabetes medication needs compared with therapeutic or nontherapeutic nonvegetarian dietary patterns (very low quality evidence).[28,36]

In adults with CVD, there was no significant difference in blood pressure, lipid profile, quality of life, cardiovascular events, or mortality from consuming vegetarian, including vegan, dietary patterns compared with therapeutic or nontherapeutic nonvegetarian dietary patterns.[28] Thus, efficacy was equal to other therapeutic diets examined for CVD, including a traditional cardiac rehabilitation diet[37]

	All Vegetarian Diets			
	General Healthy, Adult Population *Primordial & Primary Prevention*	**Adults with High Risk of Cardiovascular Disease** *Secondary Prevention*	**Adults with Cardiovascular Disease** *Tertiary Prevention/Disease Management*	**Adults with Type 2 Diabetes** *Tertiary Prevention/Disease Management*
Likely Benefit	Cardiovascular disease incidence ● Coronary heart disease incidence ●	BMI*,† ● Percent weight loss* ● Total cholesterol* ● LDL cholesterol*,† ●	---	HbA1c*,† ● BMI*,† ●
Possible Benefit	Cardiovascular disease mortality ◑ Coronary heart disease mortality ◑ Cancer incidence ○ C-reactive protein ◑	Blood glucose* ◑	---	Diabetes medication dosage† ○ Metabolic clearance rate of glucose† ○
May Be No Difference	Stroke incidence ◑ Stroke mortality ◑ Cerebrovascular disease mortality ○ Fracture Risk ◑ LDL cholesterol ◑ Triglycerides ◑	Total cholesterol† ● HDL cholesterol† ● Triglycerides† ● Blood glucose† ◑ Percent weight loss† ● Adverse events† ◑ Systolic blood pressure*,† ●	Blood pressure*,† ○ Total cholesterol*,† ◑ LDL cholesterol*,† ◑ HDL cholesterol*,† ◑ Triglycerides*,† ◑ BMI*,† ◑ Quality of life*,† ◑	LDL cholesterol*,† ◑ Fasting blood glucose*,† ◑ Fasting plasma insulin† ○
Potential Harm	Bone mineral density ○ Iodine excretion ◑ Circulating ferritin ○	HDL cholesterol* ● Triglycerides* ●	---	---
Uncertain Evidence	All cause mortality ○	HbA1c*,† ○	Cardiovascular events and mortality ◑	Quality of life*,† ○

* Compared to no intervention

† Compared to therapeutic non-vegetarian diets

Certainty of Evidence: ○ = Very Low; ◑ = Low; ● = Moderate

Abbreviations: LDL, low-density lipoprotein; BMI, body mass index; HDL, high-density lipoprotein; HbA1c, glycated hemoglobin

Figure 1. Summary of evidence from the Academy of Nutrition and Dietetics' Evidence Analysis Center systematic reviews examining the impact of all vegetarian dietary patterns in adults in the general population, with cardiovascular risk factors, with cardiovascular disease, and with type 2 diabetes.[28,35,36]

or the American Heart Association Recommended Diet.[38] Evidence was rated as having low or very low quality due to lack of available evidence.

DIET QUALITY IN VEGETARIAN AND VEGAN DIETARY PATTERNS

Healthy Vegetarian and Vegan Dietary Patterns

A growing body of evidence demonstrates the importance of emphasizing diet quality when advising clients about healthy and varied vegetarian and vegan dietary patterns. Individuals can improve and maintain cardiometabolic health through an emphasis on:

- Consuming a variety of nutrient-dense whole foods that provide essential vitamins, minerals, fiber, and phytonutrients; and
- Moderating intakes of highly processed foods that are often high in saturated fats, sodium, refined carbohydrates, and added sugars.

However, even processed plant-based milk and meat alternatives tend to be higher in fiber and lower in saturated fat and cholesterol compared with animal-based products, which can be beneficial to heart health.[39-41]

The Plant-Based Diet Index (PDI) is a standardized measure used to evaluate the relationship between the degree to which diets emphasize plant-derived

	Vegan Diets			
	General Healthy, Adult Population *Primordial & Primary Prevention*	**Adults with High Risk of Cardiovascular Disease** *Secondary Prevention*	**Adults with Cardiovascular Disease** *Tertiary Prevention/Disease Management*	**Adults with Type 2 Diabetes** *Tertiary Prevention/Disease Management*
Likely Benefit	---	Total cholesterol* ● LDL cholesterol* ● BMI* ●	---	HbA1c*,† ● BMI*,† ●
Possible Benefit	Blood pressure ○ LDL cholesterol ◑ Triglycerides ○ C-reactive protein ○ BMI ○	Blood glucose* ◑	---	Diabetes medication dosage* ◑
May Be No Difference	Cardiovascular disease incidence ◑ Coronary heart disease incidence ◑ Stroke incidence ◑	Total cholesterol† ● LDL cholesterol† ● HDL cholesterol† ● Triglycerides† ● BMI† ● Blood glucose† ◑ Adverse events† ◑ Systolic blood pressure*,† ●	Total cholesterol† ◑ LDL cholesterol† ◑ HDL cholesterol† ◑ Triglycerides† ◑ BMI† ◑ Quality of life† ◑ Cardiovascular events & mortality† ◑	LDL cholesterol*,† ◑ Fasting blood glucose*,† ◑
Potential Harm	Fracture risk ◑ Bone mineral density ○ Vitamin B12 concentrations ○ Vitamin D concentrations ○	HDL cholesterol* ● Triglycerides* ●	---	---
Uncertain Evidence	Myocardial infarctions (heart attack) ○ Cardiovascular disease mortality ○ Coronary heart disease mortality ○ Cerebrovascular disease mortality ○ Type 2 diabetes incidence ○	HbA1c*,† ○ Quality of life ○	---	---

* Compared to no intervention

† Compared to therapeutic non-vegetarian diets

Certainty of Evidence: ○ = Very Low; ◑ = Low; ● = Moderate

Abbreviations: LDL, low-density lipoprotein; BMI, body mass index; HDL, high-density lipoprotein; HbA1c, glycated hemoglobin

Figure 2. Summary of evidence from the Academy of Nutrition and Dietetics' Evidence Analysis Center systematic reviews examining the influence of vegan dietary patterns in adults in the general population, with cardiovascular risk factors, with cardiovascular disease, and with type 2 diabetes.[28,35,36]

foods and limit or avoid animal-derived foods and health outcomes.[29] A healthful PDI (hPDI) emphasizes the intake of whole foods such as fruits, vegetables, whole grains, legumes, nuts, seeds, and unsaturated oils such as those derived from avocados, olives, and flaxseeds. The unhealthful PDI (uPDI) score is based on less healthy

plant-based foods like refined grains, fruit juices, sweetened beverages, sweets, and potatoes (eg, french fries, baked or mashed potatoes, or potato chips). Higher hPDI scores have been associated with health benefits, such as a lower risk of T2DM,[29] CVD,[30] and obesity,[42] whereas higher uPDI scores are associated with a higher risk of several chronic diseases.[43,44] High hPDI scores have additionally been associated with a robust and diverse gut microbiota.[45-47] A health-promoting microbiome plays a pivotal role in the regulation of metabolic, endocrine, and immune functions; the gut-brain axis; and the inflammatory response, which supports both cardiometabolic and gastrointestinal health.[48] An important functional aspect of plant-sourced foods are prebiotics, which are non-digestible dietary plant fibers that stimulate the growth of beneficial gut bacteria and confer a health benefit upon the host. Concentrated food sources of prebiotics include pulses, artichokes, whole grains, bananas, peas, beans, asparagus, garlic, leeks, and onions.[49]

Figure 3 describes principles of a healthy vegetarian/vegan dietary pattern that can be shared with clients or patients when providing nutrition education or counseling. Figure 4 (available at www.jandonline.org) is a handout practitioners can use with clients to facilitate healthy vegetarian dietary patterns.

7 Principles of Healthy Vegetarian and Vegan Dietary Patterns	
1.	**Choose a Variety.** Include a wide variety of unprocessed and minimally processed plant foods including vegetables, fruits, legumes, whole grains, nuts, and seeds.
2.	**Focus on Produce.** Make vegetables and fruits key features of every meal, aiming for a colorful variety to get a full spectrum of micronutrients.
3.	**Consume Protein Regularly.** Eat protein-rich plant foods at each meal including legumes (e.g., beans, lentils, chickpeas, split peas, peanuts, peanut butter), soy foods (e.g., tofu, tempeh, edamame, soymilk), seitan, plant-based meat alternatives, seeds, and nuts.
4.	**Focus on Fiber.** Opt for fiber-rich whole grains such as quinoa, barley, whole wheat, oats, and brown, black, or wild rice.
5.	**Choose Unsaturated Fats.** Incorporate sources of unsaturated fats such as nuts, seeds, avocados, and plant-sourced oils and fats to enhance nutrient absorption and support cardiovascular health.
6.	**Ensure Adequate Intake of Micronutrients that may be Limited.** Ensure daily consumption of essential micronutrients, with attention to those that may be limited in plant-based diets such as vitamin B12, vitamin D, calcium, iron, iodine, and choline.
7.	**Balance Energy Intake.** Eat sufficient calories to support metabolism and physical activity, but do not consume excessive calories which lead to weight gain.

Figure 3. Principles of healthy vegetarian and vegan dietary patterns.

Macronutrients to Consider

Similar to omnivorous dietary patterns, a balanced vegetarian or vegan dietary pattern should align with the Dietary Guidelines for Americans[19] and a focus on:

- Whole, minimally processed sources of carbohydrates that are dense in phytochemicals and high in fiber (eg, fruits, vegetables, whole grains, and legumes);
- Protein sources from a variety of plant foods (eg, tofu, beans, lentils, nuts, seeds, and whole grains); and,
- Plant-derived fats (eg, nuts, seeds, and avocado) and oils (eg, flaxseed and olive) that supply unsaturated fatty acids.[25]

Sound nutritional strategies central to the implementation of a successful plant-based dietary pattern ensure adequate intake of essential amino acids (EAAs) to support protein synthesis, muscle repair, growth, and immune function. Regular intake of essential fatty acids, particularly n-3 polyunsaturated fatty acids (PUFAs), is important to regulate inflammation, blood pressure, metabolism, and cell growth, among other key functions for optimal health.[50-53]

Plant Protein. Sixty percent of dietary protein consumed worldwide is derived from plant sources.[54] Plant proteins are low or devoid of saturated fat, contain no cholesterol, and boast numerous phytochemicals and fiber that animal-derived proteins lack.[49,55-57] Plant proteins have also been found to support beneficial gut bacteria and contribute to a diverse and healthy microbiome.[47] Although plant-based proteins contain all EAAs required by the body, they generally exhibit lower digestibility and may be low in specific EAAs such as lysine and methionine.[55] However, this is not of concern for most individuals because there is considerable variation in amino acid composition among protein-rich plant foods allowing for adequate consumption of all EAAs over the course of a day in a varied diet that meets energy requirements.[58,59]

Protein quality is a product of the digestibility and EAA profile of a protein source, and the amino acid requirements of the individual.[60] Currently, the digestibility-corrected amino acid score or digestible indispensable amino acid score are used to determine protein quality of individual protein sources.[61] However, protein sources are rarely eaten individually in plant-based meals; rather they are normally ingested as part of a meal that includes multiple protein-containing foods. For example, traditional vegetarian dishes such as vegetarian lasagna, cabbage rolls, pizza, bean-based chilis and burritos, veggie burgers, tofu, and plant-focused meals in general include a variety of EAAs, in varying amounts across different foods within those meals.[49,55,56] New tools

for assessing protein intakes that focus on ensuring dietary recommendations for each EAA and consider meal-based EAA requirements and digestibility,[62,63] along with Food and Agriculture Organization of the United Nations guidance on EAA assessment,[60] may be helpful for evaluating protein quality and quantity in plant-based dietary patterns.

Soy Foods. Soy is a safe, calcium- and polyphenol-rich legume mainly consumed as edamame, tofu, tempeh, or soy milk and as a main ingredient in many plant-based meat alternatives and protein powders.[64] Soy is considered a high-quality protein that is well digested and has an EAA pattern that resembles animal-sourced protein because it closely matches human requirements.[65] Soy protein has been shown to improve muscle adaptations and exercise performance,[66] lower low-density lipoprotein cholesterol levels, and improve cardiometabolic outcomes.[39,67,68] Soy product consumption, especially soymilk and tofu, is associated with lower cancer risk,[69] and fortified soy milk is considered the only nutritionally comparable beverage to cow's milk in the Dietary Guidelines for Americans, 2020-2025.[19]

Protein, Muscle, and Bone Health. Plant proteins can adequately support muscle protein synthesis (MPS) in active young adults,[70-74] with older adults potentially requiring higher protein intakes,[75,76] along with regular resistance exercise to enhance MPS.[77] Historically, beliefs and attitudes about the superiority of animal-sourced proteins and supplements (eg, whey protein powders) for optimal health and fitness have dominated dietary recommendations and guidelines.[55] However, a recent surge in plant protein research[71,78] has established a strong evidence base for plant protein viability for muscle and bone strength in active individuals and athletes and aging adults at risk of sarcopenia.[76,79,80] For healthy active adults and athletes desiring gains in muscle size and/or strength, there does not appear to be a detriment to MPS nor hypertrophy and strength outcomes when plant-protein ingestion achieves at least 1.5 g protein/kg/day.[71,74,81,82]

n-3 Fatty Acids. n-3 PUFAs are essential nutrients with diverse biological effects.[51,83-85] Alpha-linolenic acid (ALA) is generally abundant in varied plant-based diets and can be found in a variety of plant foods, including walnuts and seeds such as flax, chia, hemp, and their oils (eg, walnut, canola, hemp, and flax) and green leafy vegetables. Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) (long chain n-3s) are found in fish and other seafood via microalgae ingested by fish,[86] and are low or absent in unsupplemented vegetarian and vegan dietary patterns.[86,87] In adults, DHA is essential from a physiological perspective, particularly for normal brain functioning.[52,88,89] However, only ALA is essential as a dietary requirement through food or supplements because ALA can be converted to EPA and further into DHA, although conversion may be limited.[83,88] This conversion may be influenced by enzyme activity[90]; genetics[91]; diet composition, including the concentration of n-6 fatty acids[92]; and other factors. There is no current Dietary Reference Intake for EPA or DHA,[85] and the adequate intake recommendation for ALA is 1.1 and 1.6 g/day for women and men, respectively.[84]

Although consistent observational data suggest that higher intakes of long-chain n-3 PUFAs may be associated with lower risk for all-cause mortality and CVD,[93] depression,[94] and other conditions, interventional trials using fish oil supplements have been mainly unsuccessful across several cardiometabolic and cognitive outcomes,[94-102] and evidence is lacking for intervention trials with plant-sourced EPA/DHA supplements. In addition, vegetarians and vegans consistently show decreased risk for CVD[103-105] and other adverse outcomes that have been associated with low long-chain n-3 intake.[103,106-108] Although DHA/EPA supplements (ie, fish or algal oils) up to about 5 g/day are generally considered safe,[83] increased risks for certain CVD outcomes[101,102,109] and depression[100] in some individuals have been reported. EPA and DHA can be obtained through vegan algal supplements if desired or recommended by a nutrition and dietetics practitioner, although this may not be a requirement for health or disease prevention.[95,96,99,101,102,108,110] New methodology involving isotope studies suggest that the rate of ALA conversion may be sufficient to maintain adequate DHA levels through plant-sourced ALA consumption alone,[90,111-114] although more research is warranted.

Until consistent evidence from intervention trials can establish daily dosages for EPA/DHA in vegetarians and vegans, advice for healthy adults should focus on sufficient and regular intakes of ALA-rich foods, which also provide an array of health-promoting phytonutrients and fiber.[110] Emphasis on whole-foods approaches underscores the goal of synergistic interactions among nutrients in a varied, nutrient-dense, well-planned vegetarian and vegan dietary pattern to improve health outcomes.[115]

Micronutrients to Consider

Micronutrients of concern when consuming vegetarian, including vegan, dietary patterns include vitamin B12, iodine, iron, choline, and vitamin D. Calcium can also be a concern for vegans. Individual assessment of dietary intake, clinical status, and biochemical indicators is necessary before making specific supplement recommendations.[116-118]

Calcium. A recent systematic review and meta-analysis demonstrated little difference in calcium intake between vegetarians and omnivores, and intake was near recommended levels. However, intake was significantly lower in vegans.[119] To ensure adequate calcium intake, vegetarians and especially vegans should consume at least 2 to 3 daily servings of calcium-rich foods with good bioavailability,[120] including calcium-fortified soymilk and other calcium-fortified plant-milk alternatives, cruciferous dark leafy green vegetables such as kale, calcium-set tofu, and calcium-fortified orange juice. Bioavailability is influenced by phytate and oxalate intake.[120]

Choline. Limited evidence suggests choline intake among vegans and vegetarians may be considerably below the adequate intake.[121-125] Vegans and vegetarians should ingest a variety of nuts, legumes, soy products, cereal, and wheat germ daily to improve their choline intake.

Iodine. Findings from a meta-analysis[126] showed vegans exhibited either mild or moderate iodine deficiency more frequently than vegetarians or nonvegetarians. In 2 of 8 studies, vegans were found to be severely deficient. Plant foods do not constitute a good source of iodine except for seaweed. Vegans can improve their iodine status by ingesting iodized salt, an iodine supplement, seaweed or seaweed flakes, and/or bread made with potassium iodate or calcium iodate. Consumers should be educated on how to properly use kelp and other brown macroalgae to avoid excess iodine intake.

Iron. A systematic review of presumably healthy adults from the general population indicated vegetarian, including vegan, dietary patterns may be associated with lower circulating ferritin concentrations when compared with nonvegetarian diets, but results were mixed and certainty of evidence was very low.[28,127] Vegetarian premenopausal women have a high prevalence of iron-deficiency defined as ferritin levels <30 μg/L.[128,129] Premenopausal vegetarian women may benefit from using an iron supplement.[130] Based on limited evidence, the National Institutes of Health Office of Dietary Supplements suggests that vegetarians and vegans should consume nearly twice the recommended amount of iron due to lower absorption mainly caused by phytate content in plant foods.[131] Vegetarians should ingest a variety of iron-rich plant foods along with foods that are a rich source of vitamin C, which enhances absorption, while reducing intake of foods and beverages that are rich in iron absorption inhibitors (eg, coffee).

Vitamin B12. The high prevalence of vitamin B12 deficiency among vegetarians, especially vegans, is well documented.[132,133] Compared with those following other dietary patterns, vegans have the lowest serum/plasma B12 levels, the highest homocysteine and methylmalonic acid concentrations, and the highest incidence of deficiency and/or insufficiency.[134] Although it is possible that dietary intake from milk, dairy, and eggs may provide amounts consistent with the Recommended Dietary Allowance (RDA), higher intake may be needed to prevent vitamin B12 deficiency and insufficiency, especially in older vegans and vegetarians.[135] Using B12 supplements may be the easiest and most reliable way to ensure adequate B12 status among all vegetarians, particularly for vegans.[136,137]

Vitamin D. Although vitamin D status is largely determined by sun exposure, a 2021 systematic review of observational studies concluded that following vegan dietary patterns may be associated with lower blood total vitamin D and 25-hydroxyvitamin D concentrations compared with nonvegetarian dietary patterns, particularly in the winter, but evidence is uncertain.[138] Evidence from large cohort studies shows a high incidence of vitamin D deficiency or insufficiency in vegetarians, including vegans.[139,140] Vegan women taking vitamin D and calcium supplements had the same risk of hip fractures as nonvegetarians, whereas vegans who did not take these supplements had almost a 3 times higher risk.[140] Practitioners can follow the Endocrine Society's recommendation regarding vitamin D supplementation.[141] Although dairy milk and some brands of plant milks and fruit juices are fortified with vitamin D, it is unlikely that the RDA for vitamin D will be achieved with usual intakes of these beverages.

Navigating the Vegetarian Product Marketplace

The global vegetarian product marketplace continues to expand in response to public interest in plant-based options for health, ethical, and environmental reasons.[142] Plant-based product innovations center around developing nutrient-dense alternatives to animal foods and delivering on taste, nutrition, and sustainability.[143,144] The global plant-based food market is forecasted to expand from $11.3 billion in 2023 to $35.9 billion in 2033.[145] This sector consists of a wide range of products that include plant-based nondairy beverages and vegan foods intended to replace and perform similarly to meat and eggs in meals and cooking.

Novel plant-based foods such as plant-based meat alternatives have been created to mimic and replace animal-based foods.[40] Although some plant-based alternatives have the potential to be healthier,[41,78] have smaller environmental footprints,[146] and provide nutrient-rich alternatives to animal-based foods, other convenience plant-based alternative foods may be high in sodium, saturated fats, additives, and preservatives. Although plant-based alternatives, including plant milks, meet the definition of ultraprocessed foods, plant-based alternatives have not been associated with the same negative health effects as other ultraprocessed foods such as sodas and ultraprocessed animal products.[147,148] In addition, plant-based milks and other vegan foods intended to replace or serve as alternatives to animal-based foods may be key sources of nutrients.[149,150]

There is a strong rationale for improving consumer awareness regarding the value of these foods in achieving dietary goals as well as health considerations with overconsumption of extensively processed options as a replacement for whole plant food dietary staples.[151] Novel plant-based foods can be included in a healthy, well-balanced vegetarian dietary pattern, along with a focus on a variety of whole plant-based foods.

Plant-based alternatives can benefit those who might be transitioning to a vegetarian dietary pattern or have limited culinary skills to cook vegetarian meals while offering convenience and sensory attributes. Plant-based alternative foods and beverages may also provide micronutrients such as vitamin D, vitamin B12, calcium, and iron.[152] These food options may also pose challenges, such as the degree of processing ranging from minimally to highly processed[153]; the high amounts of fat, sodium, added sugar, calories and, in some cases, saturated fat[153,154]; and the use of additives that may be problematic for some individuals with allergies or sensitivities.[155] To help address these challenges, RDNs and NDTRs can provide their clients with a balanced perspective on the pros and cons of incorporating plant-based alternatives, encourage moderation in consumption and label reading for nutrient information, and act as advocates for healthier versions of processed foods.[152] Figure 3 provides an overview of principles of healthy vegetarian and vegan dietary patterns that can be used when counseling clients. Figure 5 describes important resources on vegetarian and vegan dietary patterns available through the Academy and other reputable sources.[156]

Academy of Nutrition and Dietetics/Vegetarian Nutrition Dietetic Practice Group

- Research-based Vegetarian Diet Fact Sheets on a variety of topics: www.vndpg.org/vn/resources/vegetarian-dietitian-resources
- Culture Cuisine Plates: www.vndpg.org/idea/culture-plates
- Building a Healthy Vegetarian Diet: Myths and Facts: www.eatright.org/health/wellness/vegetarian-and-plant-based/building-a-healthy-vegetarian-diet-myths
- Vegetarianism: The Basic Facts: www.eatright.org/health/wellness/vegetarian-and-plant-based/vegetarianism-the-basic-facts
- Healthful Vegetarian Meal Ideas: www.eatright.org/food/food-preparation/cooking-tips/healthful-vegetarian-meal-ideas
- Vegging Out: Tips on Switching to a Meatless Diet: www.eatright.org/health/wellness/vegetarian-and-plant-based/vegging-out-tips-on-switching-to-a-meatless-diet
- Food Sources of Five Important Nutrients for Vegetarians: www.eatright.org/health/wellness/vegetarian-and-plant-based/food-sources-of-5-important-nutrients-for-vegetarians

Other Resources[a]

- American College of Lifestyle Medicine: https://lifestylemedicine.org/wp-content/uploads/2022/07/Eating-on-Budget.pdf
- Vegetarian Resource Group
  - Vegetarianism in a Nutshell: www.vrg.org/nutshell/nutshell.htm
  - Vegan Diets in a Nutshell: www.vrg.org/nutshell/vegan_nutshell.pdf
  - My Vegan Plate food plan: www.vrg.org/nutshell/MyVeganPlate.pdf
  - Low-Cost Vegan Menus: www.vrg.org/journal/vj2020issue2/2020_issue2_vegan_menus.php
- Oldways
  - Vegetarian and Vegan Diet Pyramid: https://oldwayspt.org/traditional-diets/vegetarian-vegan-diet
  - The African Heritage Power Plate: https://oldwayspt.org/wp-content/uploads/2024/06/African-Heritage-Power-Plate-Booklet.pdf
- The Vegan RD
  - Vegan Nutrition Primers: www.theveganrd.com/vegan-nutrition-101/vegan-nutrition-primers/
- Vegan Health
  - Nutrition Tips for Vegans: https://veganhealth.org/tips-for-new-vegans/

Figure 5. Resources for implementing vegetarian, including vegan, dietary patterns. [a]Resources listed may be helpful for practitioners but are not endorsed by the Academy of Nutrition and Dietetics.

VEGETARIAN DIETARY PATTERNS FOR DISEASE PREVENTION AND MANAGEMENT

Vegetarian and vegan dietary patterns can be recommended by RDNs, when appropriate, for prevention and management of some chronic diseases using the Nutrition Care Process (Figure 6). For clients who are not already following a vegetarian or vegan dietary pattern, RDNs and NDTRs should discuss the potential benefits and concerns of following such dietary patterns. For clients who express interest in this option, RDNs and NDTRs should help facilitate a healthy vegetarian or vegan dietary pattern. The

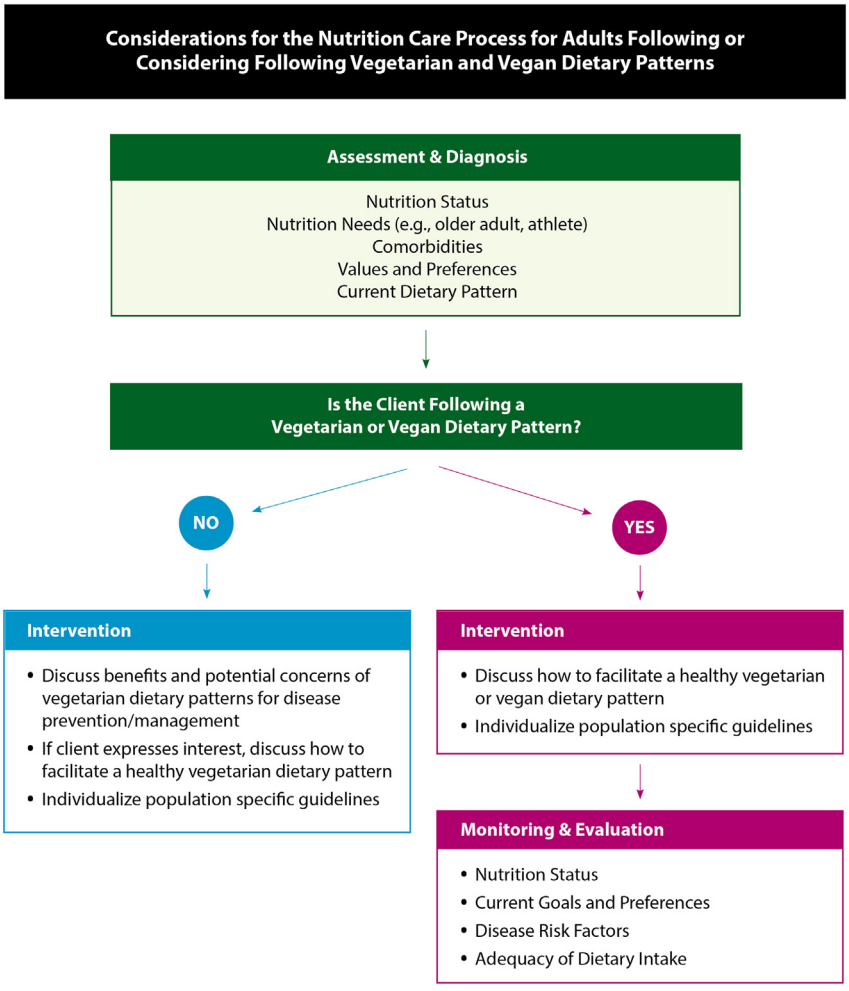

Figure 6. Considerations for registered dietitian nutritionists using the Nutrition Care Process for adults following or considering following vegetarian and vegan dietary patterns.

sections below describe considerations for practitioners when recommending and/or facilitating vegetarian dietary patterns with different populations (eg, generally healthy individuals and older adults) and conditions (eg, cardiovascular risk or disease and T2DM).

Facilitating Vegetarian, Including Vegan, Dietary Patterns for Disease Prevention

RDN and NDTR counseling may be beneficial for adults who are already following vegetarian or vegan dietary patterns and adults who may consider following these dietary patterns to reduce disease risk or for other reasons. In both populations, RDNs and NDTRs can stress the importance of following a nutrient-dense, healthy vegetarian or vegan dietary pattern. To ensure nutrient adequacy, practitioners can guide clients to focus on heart-healthy vegetarian and vegan dietary patterns, with inclusion of whole foods such as fruits, vegetables, legumes, whole grains, nuts, seeds, and oils that provide unsaturated fats.

For clients who may benefit from and express interest in following vegetarian or vegan dietary patterns, practitioners can discuss the potential benefits for cardiometabolic health and disease prevention and illustrate what a healthy vegetarian or vegan dietary pattern looks like and how it can be incorporated into daily living. In adults who already follow nutrient-dense vegetarian or vegan dietary patterns, clients can be reassured that they are making cardioprotective dietary choices. However, clients should also be aware of associations between vegetarian and vegan dietary patterns and reduced bone mineral density and reduced ferritin and iodine biomarker concentrations, and strategies to ensure adequate intake of these essential nutrients should be discussed.[28,157-160] Vegan clients should also be aware of the potential for increased fracture risk,[157] reduced bone mineral density,[28,157-160] and low concentrations of vitamins B12[132,138,161] and D,[138] although available evidence was of low or very low quality.[28] Discussions about potential concerns and their associated level of evidence can guide shared decision making between the practitioner and client about how to mitigate risk or treat deficiencies. RDNs and NDTRs can use the resources provided in Figure 4 (available at www.jandonline.org) and Figure 5, respectively.

Incorporating Vegetarian and Vegan Dietary Patterns as Part of Outpatient Care

For clients in outpatient care with cardiometabolic disease or risk factors, RDNs and NDTRs can discuss potential benefits and concerns of vegetarian, including vegan, dietary patterns as a potential therapeutic option to meet their individual health goals. For individuals who may benefit from and express interest in this option, an RDN can collaborate with them to progressively incorporate more plant-based foods into their daily menus. RDNs and NDTRs should make clients aware that vegetarian dietary patterns are about more than avoiding animal products, and, like all diets, should be planned appropriately to avoid common nutrient deficiencies. RDNs can take cues from clients about an appropriate pace for introducing new habits (eg, starting with a meatless Monday dinner) and incorporating new foods that appeal to the client (eg, meat alternatives on a breakfast sandwich). Clients may be interested in increasing the number of plant-based meals in their diet but may not yet be ready or interested in transitioning to a full vegetarian/vegan dietary pattern. Adapting suggested interventions to clients' needs will allow for a higher likelihood of success and satisfaction. For adults with cardiometabolic risk factors or disease, population guidelines for vegetarian dietary patterns,

such as in the 2020-2025 Dietary Guidelines for Americans,[19] should be adapted to align with condition-specific needs. For example, adults with cardiometabolic risk factors should still monitor their intake of saturated fats and added sugars in the context of vegetarian or vegan dietary patterns because restricting animal products alone may not mitigate risk. Many plant foods have been associated with a lower risk of cardiometabolic risk factors and should be emphasized in outpatient settings, including but not limited to soy, legumes, nuts high in plant protein, viscous fiber, plant sterols, monounsaturated fats (with low saturated fat and cholesterol), and a variety of fruits and vegetables rich in phytochemicals and antioxidants.[104,105,162] The quality of vegetarian and vegan dietary patterns and the use of nutrient supplements to address likely deficiencies such as vitamin B12[163] should be considered on an individual basis after thorough assessment of current intake, signs and symptoms, and biochemical nutritional status when appropriate.

Incorporating Vegetarian and Vegan Diets as Part of Inpatient Care

Within inpatient settings, hospitals are increasingly offering more vegetarian and vegan food options as part of their inpatient and café menu offerings with high rates of patient satisfaction and acceptance.[16,164] Much of this momentum has come from a 2017 resolution from the American Medical Association[165] as well as from individual clinician advocates[165] calling on hospitals to provide plant-based meals and remove processed meats from menus. Beyond incorporating vegetarian, including vegan, meals in inpatient settings, patients can be educated about how to make changes to their diet post-discharge, including the health implications of fewer animal-based foods. Findings from several hospital systems that have implemented exclusive plant-based or vegetarian meal options[166] within inpatient settings indicate that customer satisfaction was not affected, food waste did not increase, and the average cost of meals was similar to that of nonvegetarian meals or marginally less expensive.[164,167,168] The Academy supports inclusion of nutrient-dense plant-based meal options in inpatient settings to meet the cultural, health, religious, and sustainability preferences of patients.

VEGETARIAN DIETARY PATTERNS FOR NUTRITIONALLY AT-RISK POPULATIONS

Older Adults

Increased longevity has been observed in vegetarian populations; however, there are areas of concern for nutritional adequacy and health outcomes in older adults.[169] Although research with older vegetarians is limited, plant-based dietary patterns (not specifically vegetarian or vegan dietary patterns) that emphasize healthier options have been associated with a lower risk of frailty,[170,171] cognitive decline,[172] dementia and depression,[173] and higher bone mineral density[174] in older adults. Older adults should choose nutrient-dense meals because energy needs generally decrease with aging, whereas some nutrient requirements, such as protein and calcium, may increase.

Protein intake plays an important role in maintaining the health status of older adults, with plant protein being associated with higher odds of healthy aging.[175] Protein intakes above the RDA coupled with resistance exercise appear to reduce the risk of sarcopenia.[176] Building and maintaining muscle mass is a key component of health and performance across the lifespan. Although the Dietary Reference Intake is set at 0.8 g protein/kg body weight/day,[84] older individuals should increase dietary protein intakes to at least 1 g protein/kg/day, based on healthy body weight, to aid in the prevention of age-related decline in skeletal muscle mass and function (sarcopenia).[177-179] Both animal and plant-derived proteins provided at intakes exceeding the current RDA enhance MPS in older adults and may help overcome age-related anabolic resistance.[76] Older adults living in long-term care facilities or attending congregate feeding programs or receiving home-delivered meal services should have access to nutritious vegetarian and vegan meals of their choice. RDNs and NDTRs can provide support to help older adults access these meals.

Adults with Food Insecurity or Low Socioeconomic Status

Healthy plant-based diets may help decrease mortality risks across socioeconomic deprivation levels, especially for those who are the most socioeconomically deprived.[180] Programs such as the Supplemental Nutrition Assistance Program, food banks, food pantries, and senior nutrition programs should include foods and educational resources that support vegetarian and vegan dietary patterns. The Dietary Guidelines for Americans' "Healthy Vegetarian Dietary Pattern" was estimated to cost slightly more than the current American diet; other recommended patterns were more expensive.[181] Limited research suggests that a vegan diet can cost less than a diet that includes meat, dairy, and other animal products.[182,183] Factors such as food prices,[184] significant subsidies for animal foods,[185] restricted access to health-supporting foods, easy access to inexpensive commodified food products,[186] limited time, and inadequate equipment for food storage and preparation can make it challenging for consumers with limited incomes to follow healthy vegetarian or vegan dietary patterns. RDNs and NDTRs can provide external support to help patients and clients overcome these barriers.

FACILITATING VEGETARIAN AND VEGAN DIETARY PATTERNS WITH DIVERSE CLIENTS

High quality health care delivery for a growing, culturally diverse population requires that RDNs and NDTRs support and design culturally sensitive,[49,187] patient-centered dietary interventions. In addition, as food environments change, cultural dietary practices, including long-standing traditions of plant-based diets, are likely to be displaced or modified, resulting in positive[188] or negative effects with health implications.[189,190] For example, an increase in fruit and vegetable consumption would be a positive effect, whereas replacing healthy whole grains with refined processed grains would be a negative effect. Against this backdrop, genetic predispositions, chronic stress, and acculturative lifestyle behaviors such as sedentarism further exacerbate the situation. RDNs and NDTRs should have an

understanding of the psychosociocultural and environmental contexts of the patient or client.[191,192] Deliberate strategies (eg, recipe modifications or finding healthier alternatives) should be employed to reinstate healthier, nutrient-dense plant-based foods that are familiar and culturally appropriate.

FUTURE RESEARCH NEEDS

There are many research gaps regarding the health benefits and concerns of vegetarian and vegan dietary patterns for adults in preventing, treating, and managing disease. Much of the evidence from systematic reviews included in this Position Paper was graded as low or very low quality due to methodological limitations (Figure 1 and Figure 2),[28,35,36] indicating a priority for further high-quality research in this area. In addition, no systematic reviews were identified that reported on the associations between vegetarian or vegan dietary patterns and incidence of hypertension or overweight/obesity in the general population. Research gaps have been identified for many indicators of nutritional status in adult vegetarians and vegans.[28]

There is limited recent research examining food choices and factors related to the accessibility and affordability of acquiring vegetarian and vegan foods. Other topics warranting further research include supplement use, nutrient intakes, health and nutrient status of different types of vegetarian dietary patterns (eg, vegan, lacto-vegetarian, and lacto-ovo vegetarian) in the United States. Due to the diverse nature of diets categorized as vegetarian dietary patterns, differentiation by subgroups that are sensitive to cultural, social, and economic contexts is needed. Information on culturally appropriate food choices of adult vegetarians and vegans in the United States is needed to develop recommendations, such as those in the Dietary Guidelines for Americans,[19] that are reflective of the diets of and acceptable in these groups.[123]

As more novel plant-based food products are developed, determination of the extent of their use by vegetarians and vegans and the effect of the inclusion of these products on disease risk is needed. Research is also needed to determine the effectiveness of RDNs in improving nutritional outcomes and health status of vegetarians and vegans and in those adopting these dietary patterns.

CONCLUSIONS

Vegetarian and vegan dietary patterns may improve cardiometabolic disease and risk factors and align with current population and disease-specific recommendations. However, vegetarian and vegan dietary patterns may also increase concerns for some nutrient deficiencies. RDNs should offer vegetarian and vegan dietary patterns as an option for adults who may benefit from and express interest in following these patterns. RDNs and NDTRs should emphasize consumption of high-quality plant-based foods rather than solely focusing on the avoidance of animal-sourced foods. In all cases, vegetarian and vegan dietary recommendations should be tailored to client values, preferences, lifestyle, and special circumstances. The Academy is a leader in creating practitioner and client resources to facilitate healthy dietary patterns, including vegetarian and vegan dietary patterns. In addition, the Academy advocates for policies and legislation that support equitable access to more plant-based foods in a variety of settings (eg, schools, child-care nutrition programs, and federal assistance programs) and within clinical care to meet the cultural, customary eating pattern, religious, and sustainability preferences of individuals. Promoting and facilitating healthy vegetarian and vegan dietary patterns at the population and individual levels is an important mechanism for improving several outcomes associated with cardiometabolic diseases.

References

1. Jones JM. U.S., 4% identify as vegetarian, 1% as vegan; Published 2023. Accessed July 15, 2024. https://news.gallup.com/poll/510038/identify-vegetarian-vegan.aspx
2. Hardt L, Mahamat-Saleh Y, Aune D, Schlesinger S. Plant-based diets and cancer prognosis: a review of recent research. *Curr Nutr Rep*. 2022;11(4):695-716.
3. Rajaram S, Jones J, Lee GJ. Plant-based dietary patterns, plant foods, and age-related cognitive decline. *Adv Nutr*. 2019;10(suppl 4):S422-S436.
4. Trautwein EA, McKay S. The role of specific components of a plant-based diet in management of dyslipidemia and the impact on cardiovascular risk. *Nutrients*. 2020;12(9):2671.
5. Sarkar D, Christopher A, Shetty K. Phenolic bioactives from plant-based foods for glycemic control. *Front Endocrinol (Lausanne)*. 2021;12: 727503.
6. Gibbs J, Cappuccio FP. Plant-based dietary patterns for human and planetary health. *Nutrients*. 2022;14(8):1614.
7. Sustainable healthy diets: guiding principles. World Heath Organization. 2019. Accessed February 7, 2025. https://www.who.int/publications/i/item/9789241516648
8. Willett W, Rockström J, Loken B, et al. Food in the anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet*. 2019;393(10170):447-492.
9. Fresán U, Sabaté J. Vegetarian diets: planetary health and its alignment with human health. *Adv Nutr*. 2019;10(Suppl 4):S380-S388.
10. Moreno LA, Meyer R, Donovan SM, et al. Perspective: Striking a balance between planetary and human health-is there a path forward? *Adv Nutr*. 2022;13(2):355-375.
11. Leitzmann C. Vegetarian nutrition: past, present, future. *Am J Clin Nutr*. 2014;100(Suppl 1):496s-502s.
12. Palmer S. Ethics in the plant-based food movement. *Today's Dietitian*. 2020;22(8):24.
13. Mace JL, McCulloch SP. Yoga, ahimsa and consuming animals: UK yoga teachers' beliefs about farmed animals and attitudes to plant-based diets. *Animals (Basel)*. 2020;10(3).
14. Storz MA, Müller A, Lombardo M. Diet and consumer behavior in U.S. vegetarians: a National Health and Nutrition Examination Survey (NHANES) data report. *Int J Environ Res Public Health*. 2021;19(1):67.
15. Kamiński M, Skonieczna-Żydecka K, Nowak JK, Stachowska E. Global and local diet popularity rankings, their secular trends, and seasonal variation in Google Trends data. *Nutrition*. 2020;79-80: 110759.
16. Landry MJ, Ward CP. Health benefits of a plant-based dietary pattern and implementation in healthcare and clinical practice. *Am J Lifestyle Med*; 2024: 15598276241237766.
17. Hargreaves SM, Rosenfeld DL, Moreira AVB, Zandonadi RP. Plant-based and vegetarian diets: an overview and definition of these dietary patterns. *Eur J Nutr*. 2023;62(3):1109-1121.
18. Corichi M. Eight-in-ten Indians limit meat in their diets, and four-in-ten consider themselves vegetarian. Pew Research Center. Published 2021. Updated July 8, 2021. Accessed May 24, 2024. https://www.pewresearch.org/short-reads/2021/07/08/eight-in-ten-indians-limit-meat-in-their-diets-and-four-in-ten-consider-themselves-vegetarian/
19. Dietary Guidelines for Americans. 2020-2025. 9th edition. US Depts of Agriculture and Health and Human Services.

December 2020. Accessed February 7, 2025. https://www.dietaryguidelines.gov/sites/default/files/2020-12/Dietary_Guidelines_for_Americans_2020-2025.pdf

20. NOURISHING and MOVING policy databases. World Cancer Research Fund International. Accessed May 24, 2024. https://policydatabase.wcrf.org/
21. Cara KC, Goldman DM, Kollman BK, Amato SS, Tull MD, Karlsen MC. Commonalities among dietary recommendations from 2010 to 2021 Clinical Practice Guidelines: a meta-epidemiological study from the American College of Lifestyle Medicine. *Adv Nutr*. 2023;14(3):500-515.
22. ElSayed NA, Aleppo G, Aroda VR, et al. 2. Classification and Diagnosis of Diabetes: Standards of Care in Diabetes-2023. *Diabetes Care*. 2023;46(Suppl 1):S19-S40.
23. Virani SS, Newby LK, Arnold SV, et al. 2023 AHA/ACC/ACCP/ASPC/NLA/PCNA Guideline for the Management of Patients With Chronic Coronary Disease: a report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines. *Circulation*. 2023;148(9):e9-e119.
24. Lichtenstein AH, Appel LJ, Vadiveloo M, et al. 2021 Dietary Guidance to Improve Cardiovascular Health: a Scientific Statement From the American Heart Association. *Circulation*. 2021;144(23):e472-e487.
25. Gardner CD, Vadiveloo MK, Petersen KS, et al. Popular dietary patterns: alignment with American Heart Association 2021 Dietary Guidance: a Scientific Statement From the American Heart Association. *Circulation*. 2023;147(22):1715-1730.
26. Hauser ME, McMacken M, Lim A, Shetty P. Nutrition—an evidence-based, practical approach to chronic disease prevention and treatment. *J Fam Pract*. 2022;71(Suppl 1 Lifestyle):S5-S16.
27. Kushi LH, Byers T, Doyle C, et al. American Cancer Society Guidelines on Nutrition and Physical Activity for cancer prevention: reducing the risk of cancer with healthy food choices and physical activity. *CA Cancer J Clin*. 2006;56(5):254-281. quiz 313-254.
28. Raj SLM, Mangels R, Guest N, Pawlak R, Handu D, Rozga M. Vegetarian nutrition. Academy of Nutrition and Dietetics Evidence Analysis Library Website. Updated February 2024. Published 2024. Accessed March 4, 2024. https://andeal.org/veg
29. Satija A, Bhupathiraju SN, Rimm EB, et al. Plant-based dietary patterns and incidence of type 2 diabetes in US men and women: results from three prospective cohort studies. *PLoS Med*. 2016;13(6):e1002039.
30. Satija A, Bhupathiraju SN, Spiegelman D, et al. Healthful and unhealthful plant-based diets and the risk of coronary heart disease in U.S. adults. *J Am Coll Cardiol*. 2017;70(4):411-422.
31. How many vegetarians and vegans are there? The Vegetarian Resource Group. Published 2022. Accessed May 24, 2024. https://www.vrg.org/journal/vj2022issue4/2022_issue4_how_many.php
32. Handu D, Moloney L, Rozga MR, Cheng F, Wickstrom D, Acosta A. Evolving the Academy Position Paper process: commitment to evidence-based practice. *J Acad Nutr Diet*. 2018;118(9):1743-1746.
33. Higgins JPT, TJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA, eds. Cochrane Handbook for Systematic Reviews of Interventions version 6.3 Cochrane. Updated February 2022. Accessed February 7, 2025. https://training.cochrane.org/handbook/current
34. Handu D, Moloney L, Wolfram T, Ziegler P, Acosta A, Steiber A. Academy of Nutrition and Dietetics Methodology for conducting systematic reviews for the Evidence Analysis Library. *J Acad Nutr Diet*. 2016;116(2):311-318.
35. Landry MJ, Senkus KE, Mangels AR, et al. Vegetarian dietary patterns and cardiovascular risk factors and disease prevention: an umbrella review of systematic reviews. *Am J Prev Cardiol*. 2024;20: 100868.
36. Guest NS, Raj S, Landry MJ, et al. Vegetarian and vegan dietary patterns to treat adult type 2 diabetes: a systematic review and meta-analysis of randomized controlled trials. *Adv Nutr*. 2024:100294.
37. Aldana SG, Greenlaw R, Salberg A, Merrill RM, Hager R, Jorgensen RB. The effects of an intensive lifestyle modification program on carotid artery intima-media thickness: a randomized trial. *Am J Health Promot*. 2007;21(6):510-516.
38. Shah B, Newman JD, Woolf K, et al. Anti-inflammatory effects of a vegan diet versus the American Heart Association-Recommended Diet in Coronary Artery Disease Trial. *J Am Heart Assoc*. 2018;7(23): e011367.
39. Erlich MN, Ghidanac D, Blanco Mejia S, et al. A systematic review and meta-analysis of randomized trials of substituting soymilk for cow's milk and intermediate cardiometabolic outcomes: understanding the impact of dairy alternatives in the transition to plant-based diets on cardiometabolic health. *BMC Med*. 2024;22(1):336.
40. Najera Espinosa S, Hadida G, Jelmar Sietsma A, et al. Mapping the evidence of novel plant-based foods: a systematic review of nutritional, health, and environmental impacts in high-income countries. *Nutr Rev*. Apri 24, 2024. Published online.
41. Nagra M, Tsam F, Ward S, Ur E. Animal vs plant-based meat: a hearty debate. *Can J Cardiol*. 2024;40(7):1198-1209.
42. Jarvis SE, Nguyen M, Malik VS. Association between adherence to plant-based dietary patterns and obesity risk: a systematic review of prospective cohort studies. *Appl Physiol Nutr Metab*. 2022;47(12):1115-1133.
43. Thompson AS, Candussi CJ, Tresserra-Rimbau A, et al. A healthful plant-based diet is associated with lower type 2 diabetes risk via improved metabolic state and organ function: A prospective cohort study. *Diabetes Metab*. 2024;50(1): 101499.
44. Thompson AS, Tresserra-Rimbau A, Karavasiloglou N, et al. Association of healthful plant-based diet adherence with risk of mortality and major chronic diseases among adults in the UK. *JAMA Netw Open*. 2023;6(3): e234714.
45. Aljuraiban GS, Aljazairy EA, Alsahli AS, Sabico S, Al-Musharaf S. Plant-based dietary index in relation to gut microbiota in Arab women. *Medicine (Baltimore)*. 2023;102(38): e35262.
46. Miao Z, Du W, Xiao C, et al. Gut microbiota signatures of long-term and short-term plant-based dietary pattern and cardiometabolic health: a prospective cohort study. *BMC Med*. 2022;20(1):204.
47. Shen X, Tilves C, Kim H, et al. Plant-based diets and the gut microbiome: findings from the Baltimore Longitudinal Study of Aging. *Am J Clin Nutr*. 2024;119(3):628-638.
48. Tomova A, Bukovsky I, Rembert E, et al. The effects of vegetarian and vegan diets on gut microbiota. *Front Nutr*. 2019;6:47.
49. Craig WJ, Mangels AR, Fresán U, et al. The safe and effective use of plant-based diets with guidelines for health professionals. *Nutrients*. 2021;13(11):4144.
50. Zhang Y, Sun Y, Yu Q, et al. Higher ratio of plasma omega-6/omega-3 fatty acids is associated with greater risk of all-cause, cancer, and cardiovascular mortality: a population-based cohort study in the UK Biobank. *Elife*. 2024;12.
51. Djuricic I, Calder PC. Pros and cons of long-chain omega-3 polyunsaturated fatty acids in cardiovascular health. *Annu Rev Pharmacol Toxicol*. 2023;63:383-406.
52. Gould JF, Roberts RM, Makrides M. The influence of omega-3 long-chain polyunsaturated fatty acid, docosahexaenoic acid, on child behavioral functioning: a review of randomized controlled trials of DHA supplementation in pregnancy, the neonatal period and infancy. *Nutrients*. 2021;13(2):415.
53. Skulas-Ray AC, Wilson PWF, Harris WS, et al. Omega-3 fatty acids for the management of hypertriglyceridemia: a science advisory from the American Heart Association. *Circulation*. 2019;140(12):e673-e691.
54. Food and Agriculture Organization of the United Nations (2023) – with major processing by Our World in Data. "Daily supply of protein from animal products – FAO" [dataset]. Food and Agriculture Organization of the United Nations, "Food Balances: Food Balances (-2013, old methodology and population)"; Food and Agriculture Organization of the United Nations, "Food Balances: Food Balances (2010-)" [original data]. Accessed February 19, 2025. https://ourworldindata.org/grapher/daily-protein-supply-from-animal-and-plant-based-foods
55. Pinckaers PJM, Trommelen J, Snijders T, van Loon LJC. The anabolic response to plant-based protein ingestion. *Sports Med*. 2021;51(suppl 1):59-74.
56. Hertzler SR, Lieblein-Boff JC, Weiler M, Allgeier C. Plant proteins: assessing their nutritional quality and effects on health and physical function. *Nutrients*. 2020;12(12):3704.

57. Dwivedi S, Singh V, Sharma K, Sliti A, Baunthiyal M, Shin JH. Significance of soy-based fermented food and their bioactive compounds against obesity, diabetes, and cardiovascular diseases. *Plant Foods Hum Nutr*. 2024;79(1):1-11.

58. Rolands MR, Hackl LS, Bochud M, Le KA. Protein adequacy, plant protein proportion and main plant protein sources consumed across vegan, vegetarian, pesco-vegetarian and semi-vegetarian diets: a systematic review. *J Nutr*. 2025;155(1):153-167.

59. Segovia-Siapco G, Sabate J. Health and sustainability outcomes of vegetarian dietary patterns: a revisit of the EPIC-Oxford and the Adventist Health Study-2 cohorts. *Eur J Clin Nutr*. 2019;72(suppl 1):60-70.

60. Dietary protein quality evaluation in human nutrition. Report of an FAQ Expert Consultation. *FAO Food Nutr Pap*. 2013;92:1-66.

61. Moughan PJ, Lim WXJ. Digestible indispensable amino acid score (DIAAS): 10 years on. *Front Nutr*. 2024;11: 1389719.

62. Forester SM, Jennings-Dobbs EM, Sathar SA, Layman DK. Perspective: Developing a nutrient-based framework for protein quality. *J Nutr*. 2023;153(8):2137-2146.

63. Grootswagers P, Hojlund Christensen S, Timmer M, Riley W, de Groot L, Tetens I. Meal protein quality score: a novel tool to evaluate protein quantity and quality of meals. *Curr Dev Nutr*. 2024;8(9):104439.

64. Rizzo G, Baroni L. Soy, soy foods and their role in vegetarian diets. *Nutrients*. 2018;10(1):43.

65. Limone P, Messina G, Toto GA. Serious games and eating behaviors: a systematic review of the last 5 years (2018-2022). *Front Nutr*. 2022;9: 978793.

66. Zare R, Devrim-Lanpir A, Guazzotti S, et al. Effect of soy protein supplementation on muscle adaptations, metabolic and antioxidant status, hormonal response, and exercise performance of active individuals and athletes: a systematic review of randomised controlled trials. *Sports Med*. 2023;53(12):2417-2446.

67. Blanco Mejia S, Messina M, Li SS, et al. A meta-analysis of 46 studies identified by the FDA demonstrates that soy protein decreases circulating LDL and total cholesterol concentrations in adults. *J Nutr*. 2019;149(6):968-981.

68. Asbaghi O, Ashtary-Larky D, Mousa A, Rezaei Kelishadi M, Moosavian SP. The effects of soy products on cardiovascular risk factors in patients with type 2 diabetes: a systematic review and meta-analysis of clinical trials. *Adv Nutr*. 2022;13(2):455-473.

69. Wang C, Ding K, Xie X, et al. Soy product consumption and the risk of cancer: a systematic review and meta-analysis of observational studies. *Nutrients*. 2024;16(7):986.

70. Pinckaers PJM, Smeets JSJ, Kouw IWK, et al. Post-prandial muscle protein synthesis rates following the ingestion of pea-derived protein do not differ from ingesting an equivalent amount of milk-derived protein in healthy, young males. *Eur J Nutr*. 2024;63(3):893-904.

71. Hevia-Larrain V, Gualano B, Longobardi I, et al. High-protein plant-based diet versus a protein-matched omnivorous diet to support resistance training adaptations: a comparison between habitual vegans and omnivores. *Sports Med*. 2021;51(6):1317-1330.

72. Pinckaers PJM, Weijzen MEG, Houben LHP, et al. The muscle protein synthetic response following corn protein ingestion does not differ from milk protein in healthy, young adults. *Amino Acids*. 2024;56(1):8.

73. Lim C, Janssen TA, Currier BS, et al. Muscle protein synthesis in response to plant-based protein isolates with and without added leucine versus whey protein in young men and women. *Curr Dev Nutr*. 2024;8(6): 103769.

74. Oikawa SY, Bahniwal R, Holloway TM, et al. Potato protein isolate stimulates muscle protein synthesis at rest and with resistance exercise in young women. *Nutrients*. 2020;12(5):1235.

75. Gorissen SH, Horstman AM, Franssen R, et al. Ingestion of wheat protein increases in vivo muscle protein synthesis rates in healthy older men in a randomized trial. *J Nutr*. 2016;146(9):1651-1659.

76. McKendry J, Lowisz CV, Nanthakumar A, et al. The effects of whey, pea, and collagen protein supplementation beyond the recommended dietary allowance on integrated myofibrillar protein synthetic rates in older males: a randomized controlled trial. *Am J Clin Nutr*. 2024;120(1):34-46.

77. Pinckaers PJ, Domic J, Petrick HL, et al. Higher muscle protein synthesis rates following ingestion of an omnivorous meal compared with an isocaloric and isonitrogenous vegan meal in healthy, older adults. *J Nutr*. 2024;154(7):2120-2132.

78. Landry MJ, Ward CP, Cunanan KM, et al. Cardiometabolic effects of omnivorous vs vegan diets in identical twins: a randomized clinical trial. *JAMA Netw Open*. 2023;6(11):e2344457.

79. Goldman DM, Warbeck CB, Karlsen MC. Completely plant-based diets that meet energy requirements for resistance training can supply enough protein and leucine to maximize hypertrophy and strength in male bodybuilders: a modeling study. *Nutrients*. 2024;16(8):1122.

80. Roberts AK, Busque V, Robinson JL, Landry MJ, Gardner CD. SWAP-MEAT Athlete (study with appetizing plant-food, meat eating alternatives trial)—investigating the impact of three different diets on recreational athletic performance: a randomized crossover trial. *Nutr J*. 2022;21(1):69.

81. Lynch H, Johnston C, Wharton C. Plant-based diets: considerations for environmental impact, protein quality, and exercise performance. *Nutrients*. 2018;10(12):1841.

82. Lynch HM, Buman MP, Dickinson JM, Ransdell LB, Johnston CS, Wharton CM. No significant differences in muscle growth and strength development when consuming soy and whey protein supplements matched for leucine following a 12 week resistance training program in men and women: a randomized trial. *Int J Environ Res Public Health*. 2020;17(11):3871.

83. Omega-3 fatty acids fact sheet for health professionals. National Institutes of Health Office of Dietary Supplements. Published 2023. Updated February 15, 2023. Accessed July 22, 2024. https://ods.od.nih.gov/factsheets/Omega3FattyAcids-HealthProfessional/#h9

84. Trumbo P, Schlicker S, Yates AA, Poos M; Food and Nutrition Board of the Institute of Medicine. The National Academies. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *J Am Diet Assoc*. 2002;102(11):1621-1630.

85. Kris-Etherton PM, Grieger JA, Etherton TD. Dietary reference intakes for DHA and EPA. *Prostaglandins Leukot Essent Fatty Acids*. 2009;81(2-3):99-104.

86. Sanders TA. DHA status of vegetarians. *Prostaglandins Leukot Essent Fatty Acids*. 2009;81(2-3):137-141.

87. Saunders AV, Davis BC, Garg ML. Omega-3 polyunsaturated fatty acids and vegetarian diets. *Med J Aust*. 2013;199(suppl 4):S22-S26.

88. Racey M, MacFarlane A, Carlson SE, et al. Dietary Reference Intakes based on chronic disease endpoints: outcomes from a case study workshop for omega 3's EPA and DHA. *Appl Physiol Nutr Metab*. 2021;46(5):530-539.

89. Sinclair AJ, Guo XF, Abedin L. Dietary alpha-linolenic acid supports high retinal DHA levels. *Nutrients*. 2022;14(2):301.

90. Metherel AH, Bazinet RP. Updates to the n-3 polyunsaturated fatty acid biosynthesis pathway: DHA synthesis rates, tetracosahexaenoic acid and (minimal) retroconversion. *Prog Lipid Res*. 2019;76:101008.

91. Chen X, Wu Y, Zhang Z, et al. Effects of the rs3834458 single nucleotide polymorphism in FADS2 on levels of n-3 long-chain polyunsaturated fatty acids: a meta-analysis. *Prostaglandins Leukot Essent Fatty Acids*. 2019;150:1-6.

92. Lands B, Bibus D, Stark KD. Dynamic interactions of n-3 and n-6 fatty acid nutrients. *Prostaglandins Leukot Essent Fatty Acids*. 2018;136:15-21.

93. Harris WS, Tintle NL, Imamura F, et al. Blood n-3 fatty acid levels and total and cause-specific mortality from 17 prospective studies. *Nat Commun*. 2021;12(1):2329.

94. Kelaiditis CF, Gibson EL, Dyall SC. Effects of long-chain omega-3 polyunsaturated fatty acids on reducing anxiety and/or depression in adults; a systematic review and meta-analysis of randomised controlled trials. *Prostaglandins Leukot Essent Fatty Acids*. 2023;192: 102572.

95. Manson JE, Cook NR, Lee IM, et al. Marine n-3 fatty acids and prevention of cardiovascular disease and cancer. *N Engl J Med*. 2019;380(1):23-32.

96. Nicholls SJ, Lincoff AM, Garcia M, et al. Effect of high-dose omega-3 fatty acids vs corn oil on major adverse cardiovascular events in patients at high cardiovascular risk: the STRENGTH randomized clinical trial. *JAMA*. 2020;324(22):2268-2280.

97. Bowman L, Mafham M, Wallendszus K, et al. Effects of n-3 fatty acid supplements in diabetes mellitus. *N Engl J Med*. 2018;379(16):1540-1550.

98. Vyas CM, Mischoulon D, Chang G, et al. Effects of vitamin d(3) and marine omega-3 fatty acids supplementation on indicated and selective prevention of depression in older adults: results from the clinical center sub-cohort of the vitamin D and omega-3 triaL (VITAL). *J Clin Psychiatry*. 2023;84(4): 22m14629.

99. Appleton KM, Voyias PD, Sallis HM, et al. Omega-3 fatty acids for depression in adults. *Cochrane Database Syst Rev*. 2021;11(11):CD004692.

100. Okereke OI, Vyas CM, Mischoulon D, et al. Effect of long-term supplementation with marine omega-3 fatty acids vs placebo on risk of depression or clinically relevant depressive symptoms and on change in mood scores: a randomized clinical trial. *JAMA*. 2021;326(23):2385-2394.

101. Herrmann W, Herrmann M. n-3 fatty acids and the risk of atrial fibrillation, review. *Diagnosis (Berl)*. 2024;11(4):345-352.

102. Gencer B, Djousse L, Al-Ramady OT, Cook NR, Manson JE, Albert CM. Effect of long-term marine ω-3 fatty acids supplementation on the risk of atrial fibrillation in randomized controlled trials of cardiovascular outcomes: a systematic review and meta-analysis. *Circulation*. 2021;144(25):1981-1990.

103. Harris WS. Achieving optimal n-3 fatty acid status: the vegetarian's challenge... or not. *Am J Clin Nutr*. 2014;100(suppl 1):449s-452s.

104. Glenn AJ, Guasch-Ferré M, Malik VS, et al. Portfolio diet score and risk of cardiovascular disease: findings from 3 prospective cohort studies. *Circulation*. 2023;148(22):1750-1763.

105. Chiavaroli L, Nishi SK, Khan TA, et al. Portfolio dietary pattern and cardiovascular disease: a systematic review and meta-analysis of controlled trials. *Prog Cardiovasc Dis*. 2018;61(1):43-53.

106. Gogga P, Mika A, Janczy A, Sztendel A, Sledzinski T, Malgorzewicz S. Profiles of serum fatty acids in healthy women on different types of vegetarian diets. *Nutrients*. 2024;16(4):516.

107. Burdge GC. α-linolenic acid interconversion is sufficient as a source of longer chain ω-3 polyunsaturated fatty acids in humans: an opinion. *Lipids*. 2022;57(6):267-287.

108. Abdelhamid AS, Brown TJ, Brainard JS, et al. Omega-3 fatty acids for the primary and secondary prevention of cardiovascular disease. *Cochrane Database Syst Rev*. 2020;3(3):CD003177.

109. Aldoori J, Zulyniak MA, Toogood GJ, Hull MA. Fish oil supplement use modifies the relationship between dietary oily fish intake and plasma n-3 PUFA levels: an analysis of the UK Biobank. *Br J Nutr*. 2024;131(9):1608-1618.

110. Burns-Whitmore B, Froyen E, Heskey C, Parker T, San Pablo G. Alpha-linolenic and linoleic fatty acids in the vegan diet: do they require dietary reference intake/adequate intake special consideration? *Nutrients*. 2019;11(10):2365.

111. Metherel AH, Valenzuela R, Klievik BJ, et al. Dietary docosahexaenoic acid (DHA) downregulates liver DHA synthesis by inhibiting eicosapentaenoic acid elongation. *J Lipid Res*. 2024: 100548.

112. Metherel AH, Irfan M, Klingel SL, Mutch DM, Bazinet RP. Compound-specific isotope analysis reveals no retroconversion of DHA to EPA but substantial conversion of EPA to DHA following supplementation: a randomized control trial. *Am J Clin Nutr*. 2019;110(4):823-831.

113. Burdge GC. alpha-linolenic acid interconversion is sufficient as a source of longer chain omega-3 polyunsaturated fatty acids in humans: an opinion. *Lipids*. 2022;57(6):267-287.

114. Domenichiello AF, Kitson AP, Bazinet RP. Is docosahexaenoic acid synthesis from alpha-linolenic acid sufficient to supply the adult brain? *Prog Lipid Res*. 2015;59:54-66.

115. Jacobs DR Jr, Gross MD, Tapsell LC. Food synergy: an operational concept for understanding nutrition. *Am J Clin Nutr*. 2009;89(5):1543s-1548s.

116. Marra MV, Bailey RL. Position of the Academy of Nutrition and Dietetics: micronutrient supplementation. *J Acad Nutr Diet*. 2018;118(11):2162-2173.

117. Mangels RMV, Messina M. *The Dietitian's Guide to Vegetarian Diets: Issues and Applications*. 4th ed. Jones & Bartlett Learning; 2022.

118. Institute of Medicine Standing Committee on the Scientific Evaluation of Dietary Reference Intakes and its Panel on Folate, Other B Vitamins, and Choline. *Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline*. National Academies Press; 1998.

119. Bickelmann FV, Leitzmann MF, Keller M, Baurecht H, Jochem C. Calcium intake in vegan and vegetarian diets: a systematic review and Meta-analysis. *Crit Rev Food Sci Nutr*. 2023;63(31):10659-10677.

120. Weaver CM, Wastney M, Fletcher A, Lividini K. An algorithm to assess calcium bioavailability from foods. *J Nutr*. 2024;154(3):921-927.

121. Wallace TC, Blusztajn JK, Caudill MA, et al. Choline: the underconsumed and underappreciated essential nutrient. *Nutr Today*. 2018;53(6):240-253.

122. Wallace TC, Fulgoni VL. Usual choline intakes are associated with egg and protein food consumption in the United States. *Nutrients*. 2017;9(8):839.

123. Hess JM. Modeling dairy-free vegetarian and vegan USDA food patterns for nonpregnant, nonlactating adults. *J Nutr*. 2022;152(9):2097-2108.

124. Hess JM, Comeau ME. Modeling lacto-vegetarian, pescatarian, and "pescavegan" USDA food patterns and assessing nutrient adequacy for healthy non-pregnant, non-lactating adults. *Front Nutr*. 2023;10: 1113792.

125. Hess JM, Comeau ME. Application of dairy-free vegetarian and vegan USDA food pattern models for non-pregnant, non-lactating healthy adults. *J Food Sci*. 2022;87(10):4703-4713.

126. Eveleigh ER, Coneyworth LJ, Avery A, Welham SJM. Vegans, vegetarians, and omnivores: how does dietary choice influence iodine intake? A systematic review. *Nutrients*. 2020;12(6):1606.

127. Haider LM, Schwingshackl L, Hoffmann G, Ekmekcioglu C. The effect of vegetarian diets on iron status in adults: a systematic review and meta-analysis. *Crit Rev Food Sci Nutr*. 2018;58(8):1359-1374.

128. Pawlak R, Berger J, Hines I. Iron status of vegetarian adults: a review of literature. *Am J Lifestyle Med*. 2018;12(6):486-498.

129. Slywitch E, Savalli C, Duarte ACG, Escrivão MAMS. Iron deficiency in vegetarian and omnivorous individuals: analysis of 1340 individuals. *Nutrients*. 2021;13(9):2964.

130. Milman N, Jønsson L, Dyre P, Pedersen PL, Larsen LG. Ferrous bisglycinate 25 mg iron is as effective as ferrous sulfate 50 mg iron in the prophylaxis of iron deficiency and anemia during pregnancy in a randomized trial. *J Perinat Med*. 2014;42(2):197-206.

131. Iron fact sheet for consumers. National Institutes of Health Office of Dietary Supplements. Published 2022. Updated April 5, 2022. Accessed June 19, 2024. https://ods.od.nih.gov/pdf/factsheets/iron-consumer.pdf

132. Obersby D, Chappell DC, Dunnett A, Tsiami AA. Plasma total homocysteine status of vegetarians compared with omnivores: a systematic review and meta-analysis. *Br J Nutr*. 2013;109(5):785-794.

133. Pawlak R, Parrott SJ, Raj S, Cullum-Dugan D, Lucus D. How prevalent is vitamin B(12) deficiency among vegetarians? *Nutr Rev*. 2013;71(2):110-117.

134. Pawlak R. Is vitamin B12 deficiency a risk factor for cardiovascular disease in vegetarians? *Am J Prev Med*. 2015;48(6):e11-e26.

135. Vitamin B12 fact sheet for health professionals. National Institutes of Health, Office of Dietary Supplements. Published 2024. Updated March 26, 2024. Accessed November 15, 2024. https://ods.od.nih.gov/factsheets/VitaminB12-HealthProfessional/

136. Doets EL, In 't Veld PH, Szczecińska A, et al. Systematic review on daily vitamin B12 losses and bioavailability for deriving recommendations on vitamin B12 intake with the factorial approach. *Ann Nutr Metab*. 2013;62(4):311-322.

137. Evatt ML, Terry PD, Ziegler TR, Oakley GP. Association between vitamin B12-containing supplement consumption and prevalence of biochemically defined B12 deficiency in adults in NHANES III (Third National Health and Nutrition Examination Survey). *Public Health Nutr*. 2010;13(1):25-31.

138. Bakaloudi DR, Halloran A, Rippin HL, et al. Intake and adequacy of the vegan diet. A systematic review of the evidence. *Clin Nutr*. 2021;40(5):3503-3521.

139. Chan J, Jaceldo-Siegl K, Fraser GE. Serum 25-hydroxyvitamin D status of vegetarians, partial vegetarians, and nonvegetarians: the Adventist Health Study-2. *Am J Clin Nutr*. 2009;89(5):1686s-1692s.

140. Thorpe DL, Beeson WL, Knutsen R, Fraser GE, Knutsen SF. Dietary patterns and hip fracture in the Adventist Health Study 2: combined vitamin D and calcium supplementation mitigate increased hip fracture risk among vegans. *Am J Clin Nutr*. 2021;114(2):488-495.

141. Demay MB, Pittas AG, Bikle DD, et al. Vitamin D for the prevention of disease: an Endocrine Society Clinical Practice Guideline. *J Clin Endocrinol Metab*. 2024;109(8):1907-1947.

142. Eating plant-based alternatives: limiters vs vegans. Euromonitor International. Published 2022. Updated December 2, 2022. Accessed May 14, 2024. https://www.euromonitor.com/article/eating-plant-based-alternatives-limiters-vs-vegans

143. Nourishing the future: innovations to grow the plant-based market. Unilever. Published 2021. Updated September 3, 2021. Accessed May 24, 2024. https://www.unilever.com/news/news-search/2021/nourishing-the-future-innovations-to-grow-the-plant-based-market/

144. What's next in plant-based? Nestle accelerates innovation with new shirmp and egg alternatives. Food Navigator Europe. Published 2024. Accessed May 24, 2024. https://www.foodnavigator.com/Article/2021/10/07/What-s-next-in-plant-based-Nestle-accelerates-innovation-with-new-shrimp-and-egg-alternatives

145. Plant-based food market. Future Market Insights Inc. Published 2023. Accessed May 24, 2024. https://www.futuremarketinsights.com/reports/plant-based-food-market

146. Carey CN, Paquette M, Sahye-Pudaruth S, et al. The environmental sustainability of plant-based dietary patterns: a scoping review. *J Nutr*. 2023;153(3):857-869.

147. Cordova R, Viallon V, Fontvieille E, et al. Consumption of ultra-processed foods and risk of multimorbidity of cancer and cardiometabolic diseases: a multinational cohort study. *Lancet Reg Health Eur*. 2023;35:100771.

148. Barbaresko J, Bröder J, Conrad J, Szczerba E, Lang A, Schlesinger S. Ultra-processed food consumption and human health: an umbrella review of systematic reviews with meta-analyses. *Crit Rev Food Sci Nutr*. 2024:1-9.

149. Mendoza K, Smith-Warner SA, Rossato SL, et al. Ultra-processed foods and cardiovascular disease: analysis of three large US prospective cohorts and a systematic review and meta-analysis of prospective cohort studies. *Lancet Reg Health Am*. 2024;37:100859.

150. Messina M, Duncan AM, Glenn AJ, Mariotti F. Perspective: Plant-based meat alternatives can help facilitate and maintain a lower animal to plant protein intake ratio. *Adv Nutr*. 2023;14(3):392-405.

151. Flint M, Bowles S, Lynn A, Paxman JR. Novel plant-based meat alternatives: future opportunities and health considerations. *Proc Nutr Soc*. 2023;82(3):370-385.

152. Mangels R. Vegan processed foods. The Vegetarian Resource Group. Published 2022. Updated 2022. Accessed May 24, 2024. https://www.vrg.org/journal/vj2022issue1/2022_issue1_vegan_processed_foods.php

153. Klemm S. Processed foods: a closer look. Published 2019. Updated January 30, 2023. Accessed May 24, 2024. https://www.eatright.org/health/wellness/diet-trends/processed-foods-whats-ok-and-what-to-avoid

154. Almarshad MI, Algonaiman R, Alharbi HF, Almujaydil MS, Barakat H. Relationship between ultra-processed food consumption and risk of diabetes mellitus: a mini-review. *Nutrients*. 2022;14(12):2366.

155. Gimenez-Arnau AM, Maibach H. Contact Urticaria. *Immunol Allergy Clin North Am*. 2021;41(3):467-480.

156. Vegetarian Nutrition Dietetic Practice Group. Homepage. Published 2024. Accessed May 24, 2024. https://www.vndpg.org/home

157. Iguacel I, Miguel-Berges ML, Gómez-Bruton A, Moreno LA, Julián C. Veganism, vegetarianism, bone mineral density, and fracture risk: a systematic review and meta-analysis. *Nutr Rev*. 2019;77(1):1-18.

158. Li J, Zhou R, Huang W, Wang J. Bone loss, low height, and low weight in different populations and district: a meta-analysis between vegans and non-vegans. *Food Nutr Res*. 2020;64.

159. Li T, Li Y, Wu S. Comparison of human bone mineral densities in subjects on plant-based and omnivorous diets: a systematic review and meta-analysis. *Arch Osteoporos*. 2021;16(1):95.

160. Ma X, Tan H, Hu M, He S, Zou L, Pan H. The impact of plant-based diets on female bone mineral density: evidence based on seventeen studies. *Medicine (Baltimore)*. 2021;100(46):e27480.

161. Bärebring L, Lamberg-Allardt C, Thorisdottir B, et al. Intake of vitamin B12 in relation to vitamin B12 status in groups susceptible to deficiency: a systematic review. *Food Nutr Res*. 2023; June;30:67.

162. Glenn AJ, Li J, Lo K, et al. The portfolio diet and incident type 2 diabetes: findings from the Women's Health Initiative Prospective Cohort Study. *Diabetes Care*. 2023;46(1):28-37.

163. Vimaleswaran KS. GeNuIne (gene-nutrient interactions) collaboration: towards implementing multi-ethnic population-based nutrigenetic studies of vitamin B(12) and D deficiencies and metabolic diseases. *Proc Nutr Soc*; 2021: 1-11.

164. Morgenstern S, Redwood M, Herby A. An innovative program for hospital nutrition. *Am J Lifestyle Med*; 2024: 15598276241283158.

165. American Medical Association. Healthful food options in health care facilities H-150.949. Published 2021. Accessed May 9, 2024. https://policysearch.ama-assn.org/policyfinder/detail/Res.%20410%20A-04?uri=%2FAMADoc%2FHOD.xml-0-627.xml

166. NYC Health + Hospitals now serving culturally-diverse plant-based meals as primary dinner option for inpatients at all of its 11 public hospitals [Press release]. NYC Health + Hospitals. January 9, 2023. https://www.nychealthandhospitals.org/

167. Saldivar B, Al-Turk B, Brown M, Aggarwal M. Successful incorporation of a plant-based menu into a large academic hospital. *Am J Lifestyle Med*. 2022;16(3):311-317.

168. Berardy A, Egan B, Birchfield N, Sabaté J, Lynch H. Comparison of plate waste between vegetarian and meat-containing meals in a hospital setting: environmental and nutritional considerations. *Nutrients*. 2022;14(6):1174.

169. Abris GP, Shavlik DJ, Mathew RO, et al. Cause-specific and all-cause mortalities in vegetarian compared with those in nonvegetarian participants from the Adventist Health Study-2 cohort. *Am J Clin Nutr*. 2024;120(4):907-917.

170. Maroto-Rodriguez J, Delgado-Velandia M, Ortolá R, et al. Plant-based diets and risk of frailty in community-dwelling older adults: the Seniors-ENRICA-1 cohort. *Geroscience*. 2023;45(1):221-232.

171. Qi R, Yang Y, Sheng B, Li H, Zhang X. Plant-based diet indices and their association with frailty in older adults: a CLHLS-based cohort study. *Nutrients*. 2023;15(24):5120.

172. Maroto-Rodriguez J, Ortolá R, García-Esquinas E, Kales SN, Rodríguez-Artalejo F, Sotos-Prieto M. Quality of plant-based diets and frailty incidence: a prospective analysis of UK biobank participants. *Age Ageing*. 2024;53(5): afae092.

173. Wu H, Gu Y, Meng G, et al. Quality of plant-based diet and the risk of dementia and depression among middle-aged and older population. *Age Ageing*. 2023;52(5):afad070.

174. Hu J, Li Y, Wang Z, et al. Association of plant-based dietary patterns with the risk of osteoporosis in community-dwelling adults over 60 years: a cross-sectional study. *Osteoporos Int*. 2023;34(5):915-923.

175. Ardisson Korat AV, Shea MK, Jacques PF, et al. Dietary protein intake in midlife in relation to healthy aging—results from the prospective Nurses' Health Study cohort. *Am J Clin Nutr*. 2024;119(2):271-282.

176. Kirwan RP, Mazidi M, Rodríguez García C, et al. 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. *Am J Clin Nutr*. 2022;115(3):897-913.

177. Traylor DA, Gorissen SHM, Phillips SM. Perspective: Protein requirements and optimal intakes in aging: are we ready to

recommend more than the Recommended Daily Allowance? *Adv Nutr*. 2018;9(3):171-182.

178. Berrazaga I, Micard V, Gueugneau M, Walrand S. The role of the anabolic properties of plant- versus animal-based protein sources in supporting muscle mass maintenance: a critical review. *Nutrients*. 2019;11(8):1825.

179. Burd NA, Gorissen SH, van Loon LJ. Anabolic resistance of muscle protein synthesis with aging. *Exerc Sport Sci Rev*. 2013;41(3):169-173.

180. Zhou L, Zhang R, Yang H, et al. Association of plant-based diets with total and cause-specific mortality across socioeconomic deprivation level: a large prospective cohort. *Eur J Nutr*. 2024;63(3):835-846.

181. Fulgoni V 3rd, Drewnowski A. An economic gap between the recommended healthy food patterns and existing diets of minority groups in the US National Health and Nutrition Examination Survey 2013-14. *Front Nutr*. 2019;6:37.

182. Kahleova H, Sutton M, Maracine C, et al. Vegan diet and food costs among adults with overweight: a secondary analysis of a randomized clinical trial. *JAMA Netw Open*. 2023;6(9):e2332106.

183. Campbell EK, Taillie L, Blanchard LM, et al. Post hoc analysis of food costs associated with Dietary Approaches to Stop Hypertension diet, whole food, plant-based diet, and typical baseline diet of individuals with insulin-treated type 2 diabetes mellitus in a nonrandomized crossover trial with meals provided. *Am J Clin Nutr*. 2024;119(3):769-778.

184. Darmon N, Drewnowski A. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: a systematic review and analysis. *Nutr Rev*. 2015;73(10):643-660.

185. Hayes J. USDA livestock subsidies near $50 billion, EWG analysis finds. Environmental Working Group. Published 2022. Accessed November 11, 2024. https://www.ewg.org/news-insights/news/2022/02/usda-livestock-subsidies-near-50-billion-ewg-analysis-finds

186. Drewnowski A. Food insecurity has economic root causes. *Nature Food*. 2022;3(8):555-556.

187. Oldways vegetarian/vegan diet pyramid. Oldway Cultural Food Traditions. Published 2024. Accessed May 24, 2024. https://oldwayspt.org/resources/oldways-vegetarianvegan-diet-pyramid

188. Lesser IA, Gasevic D, Lear SA. The association between acculturation and dietary patterns of South Asian immigrants. *PLoS One*. 2014;9(2):e88495.

189. Alegria K, Fleszar-Pavlović S, Hua J, Ramirez Loyola M, Reuschel H, Song AV. How socioeconomic status and acculturation relate to dietary behaviors within Latino populations. *Am J Health Promot*. 2022;36(3):450-457.

190. Gadgil MD, Kandula NR, Kanaya AM. Acculturation is associated with dietary patterns in South Asians in America. *J Immigr Minor Health*. 2020;22(6):1135-1140.

191. Monterrosa EC, Frongillo EA, Drewnowski A, de Pee S, Vandevijvere S. Sociocultural influences on food choices and implications for sustainable healthy diets. *Food Nutr Bull*. 2020;41(2 suppl):59s-73s.

192. Bhupathiraju SN, Sawicki CM, Goon S, et al. A healthy plant-based diet is favorably associated with cardiometabolic risk factors among participants of South Asian ancestry. *Am J Clin Nutr*. 2022;116(4):1078-1090.

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Figure 4. Practitioner-client handout to facilitate healthy vegetarian dietary patterns.

Quick Guide: Plant Foods To Meet Your Needs

Well-planned vegetarian and vegan dietary patterns can play a key role in disease prevention and treatment. However, vegetarians and vegans need to pay attention to some nutrients to make sure they get enough. Below are some ideas of plant foods that can help you meet your needs.

Nutrients To Pay Attention To	Plant-Based Food Sources
Protein	Tofu, beans, lentils, nuts, seeds, whole grains, tempeh, soy milk
Carbohydrates	Fruits, vegetables, whole grains, legumes
Fats	Nuts, seeds, avocados, olives and their oils
Omega-3 Fatty Acids	Seeds (flax, chia, hemp) walnuts, seed oils (e.g., canola, hemp, flax)
Calcium	Calcium-fortified soymilk and other plant-milk alternatives, low oxalate dark leafy green and cruciferous vegetables (e.g., kale), calcium-set tofu, calcium-fortified orange juice
Choline	Nuts, legumes, soy products, quinoa, wheat germ, cereal
Iodine	Iodized salt, seaweed/algae, seaweed flakes, bread made with potassium iodate or calcium iodate
Iron	Iron-fortified cereals, breads, plant-based meat alternatives, legumes (e.g. lentils, soybeans, white beans, chickpeas, black turtle beans, adzuki beans), spinach, peas, nuts, seeds, and some dried fruits
Vitamin B12	Fortified foods (plant milks, cereals, nutritional yeast), plant-based meat alternatives
Vitamin D	Fortified plant milks, fortified foods (cereals, tofu)

Talk to a health care practitioner, such as a registered dietitian nutritionist, if you think you may need supplements. More detailed handouts can be found at https://www.vndpg.org/vn/resources/vegetarian-dietitian-resources.

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This handout is a companion to the Academy of Nutrition and Dietetics 2025 Position Paper on Vegetarian Nutrition, and more information can be found in that document.

Figure 4. (*continued*) Practitioner-client handout to facilitate healthy vegetarian dietary patterns.