Healthy Dietary Patterns for Preventing Cardiometabolic Disease: The Role of Plant-Based Foods and Animal Products

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Abstract

Diets rich in plant foods are increasingly recommended to lower the risk of cardiometabolic diseases because of strong evidence that fruit, vegetables, legumes, whole grains, nuts, and seeds are protective. Although some animal products, such as unprocessed lean red meat, poultry, eggs, and dairy products, are recommended in dietary patterns to prevent cardiometabolic diseases, many health professionals advocate for exclusively plant-based dietary patterns. The aim of this article was to review recent evidence on the relative contributions of plant-based foods and animal products to a healthy dietary pattern. Secondary aims were to discuss current consumption patterns and adherence to dietary recommendations. Epidemiologic evidence suggests that a higher intake of plant-based foods is associated with a lower risk of cardiometabolic disease, whereas a higher meat intake increases the risk of cardiometabolic disease and the replacement of small quantities of animal protein with plant protein is associated with lower risk. Randomized controlled studies show that nutrient-dense diets containing animal protein, including some unprocessed lean meats, improve cardiovascular disease risk factors. Therefore, it is likely that the consumption of animal products, at recommended amounts, in the context of a dietary pattern that meets recommendations for fruit, vegetables, whole grains, nuts, seeds, and legumes, and does not exceed recommendations for added sugar, sodium, and saturated fat, may not increase cardiometabolic risk. Currently, adherence to these recommendations is suboptimal. Therefore, rather than debating the merits of healthy dietary patterns that are exclusively plant-based or that include animal sources in recommended amounts, the focus should be on improving overall eating patterns to align with dietary guidelines. Registered Dietitian/Nutritionists (RDNs) have the requisite nutrition expertise to facilitate change at the individual and population levels to promote adherence to healthy dietary patterns. Importantly, advocacy activities are urgently needed to create a healthier food environment, and all health professionals, including RDNs, must play a role. *Curr Dev Nutr* 2017;1:e001289.

Introduction

Poor dietary practices are a leading risk factor for illness, disability, and death worldwide and in the United States (1, 2). As such, defining dietary patterns that improve health and reduce chronic disease is of major scientific and public health importance. However, equally important, but often forgotten, is identifying healthful dietary patterns that can be followed by the general population. There is significant evidence that shows that dietary recommendations are not being met in many countries and that consumption of "empty calories" (i.e., foods high in solid fats and added sugars) is increasing globally (3). In many countries, including the United States, dietary guidelines are moving away from nutrient-based recommendations

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Abbreviations used: CVD, cardiovascular disease; DASH, Dietary Approaches to Stop Hypertension; RDN, Registered Dietitian/Nutritionist.

in favor of dietary pattern–based recommendations. Recommended dietary patterns are rich in plant-based foods such as fruit, vegetables, legumes, whole grains, nuts, seeds, soy products, and vegetable oils (4–7). They also include moderate amounts of fat-free or low-fat dairy. Many countries also recommend a variety of protein foods, including seafood, lean meats, poultry, eggs, legumes, nuts, seeds, and soy products. There is strong evidence that fruit, nonstarchy vegetables, whole grains, nuts, seeds, and legumes have beneficial health effects and higher consumption is associated with a lower risk of cardiometabolic disease (8–13). Consequently, many organizations now recommend a diet that emphasizes plant foods (14, 15). There is ongoing scientific debate, however, about the health effects of some animal products, such as unprocessed red meat, poultry, eggs, and dairy products (16). The purpose of this article was to review recent evidence on the relative contributions of plant-based foods and animal products to a healthy dietary pattern. Secondary aims were to discuss these findings in the context of current consumption patterns and adherence to dietary recommendations. The important role of Registered Dietitian/Nutritionists (RDNs) in helping individuals and the population adhere to current dietary guidelines will be described briefly.

Epidemiologic Evidence for the Association between Consumption of Plant-Based Foods and Animal Products and Cardiometabolic Disease

A significant body of epidemiologic evidence has shown that dietary patterns that are high in plant foods, including fruit, vegetables, nuts, seeds, whole grains, legumes, and soy products, are associated with a lower risk of mortality, cardiovascular disease (CVD), and type 2 diabetes (17–19). In addition, many observational studies have shown that vegetarians are at a lower risk of numerous chronic conditions than those who consume a dietary pattern high in meat products (20). A recent study showed that higher plant protein intake was associated with a lower risk of all-cause mortality and CVD mortality (21). A 3% increase in plant protein intake was associated with a 10% reduction (95% CI: 0.86, 0.95) in all-cause mortality and a 12% (95% CI: 0.80, 0.97) lower risk of CVD mortality. Conversely, a 10% increase in animal protein intake was associated with an 8% increase in the risk of CVD mortality (95% CI: 1.01, 1.16) and a nonsignificant 2% increase in the risk of all-cause mortality (95% CI: 0.98, 1.05). A limitation of these analyses is that the dietary replacement for plant and animal protein was not considered. Implicit to this is that animal protein could have increased, whereas plant protein could have decreased and vice versa. There are many other replacement scenarios as well that call for further research to be conducted. Further subgroup analysis showed that higher animal protein intake only increased the risk of CVD mortality in people with an unhealthy lifestyle, which was defined as smoking for >5 pack-years (equal to 1 pack/d for 5 y), high alcohol consumption (>14 g/d in women and >28 g/d in men), BMI (in kg/m^2) >27.5, or <150 min physical activity/wk. In contrast, higher plant protein intake was only associated with a reduced risk of all-cause mortality and cardiovascular mortality in people with an unhealthy lifestyle. In those who had a healthy lifestyle, intake of plant or animal protein was not associated with all-cause mortality or CVD mortality after adjustment for potential confounders. Because the majority of people in high-income countries have an unhealthy lifestyle, based on BMI and physical inactivity alone (22, 23), the results of this study suggest that replacing animal protein with plant protein may reduce mortality risk. In a prospective cohort study in US health professionals, Song et al. (21) showed that replacing 3% of energy from animal protein sources, including unprocessed red meat, poultry, fish, eggs, and dairy, with plant protein was associated with a 6–19% reduction in the risk of all-cause mortality; similar risk reductions were observed for CVD mortality. This suggests that substituting a small percentage of animal protein with plant protein may reduce the risk of all-cause and cardiovascular death in high-income countries (24).

Higher animal protein intake has also been associated with an increased risk of type 2 diabetes, such that per 5% increase in animal protein consumption, the risk of type 2 diabetes increases by 15% (95% CI: 1.00, 1.33) (25). In this study, the intake of plant protein was not associated with the development of type 2 diabetes after adjustment for standard risk factors and consumption of energy, fiber, and saturated fat, monounsaturated fat, polyunsaturated fat, *trans* fat, and animal protein. A recent meta-analysis of prospective cohort studies also showed an increased risk of type 2 diabetes with higher total protein intake (RR: 1.09; 95% CI: 1.06, 1.13) and animal protein intake (RR: 1.19; 95% CI: 1.11, 1.28), whereas there was no association for plant protein intake (RR: 0.95; 95% CI: 0.89, 1.02) (25). Because plant-based foods contain many cardioprotective vitamins, minerals, nutrients, and bioactives, in addition to protein, which is not an underconsumed nutrient in high-income countries, diets rich in plant-based foods should be evaluated in terms of their overall nutritional quality. Similarly, the overall quality of diets high in animal products should be considered, because many animal products are rich in nutrients and also do not increase the risk of cardiometabolic disease. In fact, similar to plant-based foods, some of the components of animal sources are protective (16).

Epidemiologic evidence shows that red and processed meats are associated with an increased risk of CVD and type 2 diabetes (21, 26, 27), whereas poultry, eggs, fish, and dairy do not increase CVD risk or CVD mortality (21, 26, 28–31). In fact, fish and dairy consumption has been associated with a lower risk of CVD and CVD death (29–31). No association has been found between the intake of fish and type 2 diabetes, but dairy intake may be protective against type 2 diabetes (32, 33). However, there is some evidence to suggest that eggs may increase the risk of type 2 diabetes, especially in US populations (34, 35). At present, evidence suggests that red meat consumption is strongly associated with a greater risk of cardiometabolic disease. Therefore, when considering the cardiometabolic effect of consuming a dietary pattern containing animal products, it is important to recognize that the associated risk may depend on the type of animal product consumed.

The evidence that shows an adverse association between animal protein and a number of major chronic diseases is derived from observational studies and therefore is subject to confounding. Thus, it is unclear whether a causative relation exists. It has been hypothesized that the association between meat consumption and higher risk of cardiometabolic diseases may be due to meat consumption being a marker of an overall less healthy diet and lifestyle, rather than meat consumption per se. In the European Prospective Investigation into Cancer and Nutrition (EPIC)–Oxford cohort, it was observed that meat eaters had the highest consumption of energy, protein, fat, and saturated fat and the lowest intake of fiber and PUFAs when compared with fish eaters, vegetarians, and vegans (36). This study suggests that meat consumers have poorer overall diet quality, which was also observed in a Finnish cohort whereby greater meat consumption was associated with lower overall diet quality after adjustment for age, energy intake, physical activity, smoking, and education (37). In this cohort, there was a direct relation between higher consumption of meat and higher physical inactivity, BMI, waist circumference, and percentage body weight. The relation between red and processed meat and BMI persisted after adjustment for age, physical activity, education, smoking, and intakes of nuts and seeds, fruit, oil, coffee, whole grains, and potatoes. Recently, it was shown in French adults that greater plant protein intake was independently associated with greater dietary diversity and higher nutrient adequacy (38). In this study, the difference between animal protein intake in the highest and lowest quartile of nutrient adequacy was 7% of total energy intake, indicating that relatively small reductions in animal protein intake in favor of plant protein improve nutritional adequacy. In summary, the epidemiologic evidence showing that higher meat consumption is associated with mortality and chronic disease development may be confounded by other diet and lifestyle factors, but modestly reducing meat consumption and including more plant-based foods will improve overall dietary quality and may reduce diet-related diseases.

Dietary Patterns Containing Animal Products and Plant-Based Foods

The results of epidemiologic research are likely influenced by confounding; therefore, to establish the cardiometabolic effects of diets containing plant-based foods and animal products, well-controlled clinical trials provide the highest evidence. The Dietary Approaches to Stop Hypertension (DASH) Diet is a nutrient-dense dietary pattern that emphasizes the consumption of fruit, vegetables, whole grains, and low-fat dairy products and limits the consumption of red meat, sweets, and snacks (39). Although this diet limits red meat consumption (0.5 servings red meat/d), approximately two-thirds of total protein intake is obtained from animal products (principally from 2.7 servings dairy/d). In the original controlled feeding study, the DASH diet reduced blood pressure to a greater extent than did the control diet (−5.5/3.0 mm Hg) after 8 wk in subjects with pre- and stage 1 hypertension (40). The control diet had a macronutrient profile similar to the average American diet and included 0.5 servings dairy/d and 1.5 servings red meat/d. Interestingly, the DASH diet also reduced blood pressure more than did a high fruit and vegetable diet (−2.7/1.9 mmHg), which had a macronutrient profile similar to the average American diet but included 8.5 servings fruit and vegetables/d, 0.3 servings dairy/d, and 1.8 servings red meat/d. These results show that including low-fat dairy as part of a diet that is rich in fruit and vegetables and low in saturated fat improves blood pressure more than an average American diet rich in fruit and vegetables.

Subsequently, Carey et al. (41) investigated the blood pressure and lipid effects of 3 healthful dietary patterns (all low in saturated fat) differing in protein, carbohydrate, and unsaturated fat content (OmniHeart Study). The high-carbohydrate diet (58% of total energy) was based on the DASH diet, whereas the high-protein diet and the high-unsaturated-fat diets replaced 10% of the calories from carbohydrates with protein or unsaturated fat, respectively. The high-protein diet included 50% of total protein from plant sources. All of the diets were high in fruit, vegetables, and grains and contained ∼1 serving red meat/d. It should be noted that the high-carbohydrate diet included 4.6 servings desserts and sweets/d compared with 2.5 and 1.7 servings/d in the protein and unsaturated-fat diets, respectively. In this study, the high-protein and unsaturated-fat diets lowered blood pressure, total cholesterol, non-HDL cholesterol, and TGs more than did the high-carbohydrate diet (42). Although all of the test diets lowered 10-y coronary artery disease risk, it was reduced to a greater extent by the high-protein and unsaturated-fat diets than with the high-carbohydrate diet. These controlled feeding studies showed that nutrient-dense, high-quality diets that include animal products can improve risk factors for CVD, thereby reducing the overall risk of CVD.

The DASH diet has also been tested in free-living populations. In the PREMIER study, individuals with pre- and stage 1 hypertension were provided with education and counseling to implement key components of the DASH diet; in addition, goals were set for weight loss, physical activity, and alcohol consumption (43). This was compared with a group who only had goals for weight loss, physical activity, and alcohol consumption and an advice-only control group. Subjects received weekly group sessions for the first 8 wk, followed by biweekly sessions until the 6-mo time point; monthly sessions were then held for the final 12 mo. After 18 mo, intakes of fruit (+1.8 servings/d), vegetables (+1.1 servings/d), and dairy products (+0.3 servings/d) were increased from baseline in the DASH diet group, but not to amounts recommended in the original DASH diet (9–12 servings fruit and vegetables/d, 2–3 servings dairy/d) and achieved in the controlled-feeding study (44). Compared with subjects in the group who only had goals for weight reduction, increasing physical activity, and reducing alcohol consumption, there was no additional blood pressure–lowering effect for those who were in the group who also implemented key components of the DASH diet (45). Compared with the advice-only control group, systolic and diastolic blood pressures were reduced by 4.3 mm Hg (95% CI: −5.9, −2.8 mm Hg) and 2.6 mm Hg (95% CI: −3.7, −1.5 mm Hg), respectively, in subjects in the DASH group. Similar reductions of 3.7 mm Hg (95% CI: −5.3, −2.1 mm Hg) and 1.7 mm Hg (95% CI: −2.8, −0.6 mm Hg) for systolic and diastolic blood pressures, respectively, were observed in the group who had lifestyle goals. This study showed that it was challenging for free-living individuals to implement a dietary pattern consistent with the DASH recommendations, which has been shown in a number of other free-living populations as well (46). Nonetheless, there were positive steps made toward adherence to a DASH diet.

In America, beef is commonly consumed and there was some concern that the restriction placed on red meat in the DASH diet may hamper compliance in this population. In the Beef in an Optimal Lean Diet (BOLD) study, a DASH diet with 28, 113, or 153 g lean beef/d lowered total and LDL cholesterol, compared with a control healthy American diet, with no difference between the diets after 5 wk (47). The apo profile was also improved after consumption of the lean beef–containing diets compared with the healthy American diet. The BOLD study included normotensive and prehypertensive subjects, and after consumption of the diet containing 153 g lean beef/d, systolic blood pressure was lower (−4.2 mm Hg) than after the other 3 diets (48). In addition, augmentation index, a measure of arterial stiffness, was lower after the diet containing 113 g lean beef/d than with the other diets. These results suggest that that the inclusion of lean beef as part of a healthy dietary pattern can reduce CVD risk factors. However, it is important to note that these effects were achieved under controlled-feeding conditions and might be more difficult to achieve in a free-living setting. In addition, the diets that included lean beef were also designed to limit saturated fat intake (6% of total energy) and "empty calorie" foods while providing large quantities of fruit and vegetables (~8 cups/d) and grains (5.3–5.6 ounces/d). The diet that provided 153 g lean beef/d also included 4.2 ounces legumes, nuts, seeds, and vegetable protein/d, and 4.7 cups low-fat dairy products. Therefore, these diets contained many nutrient-dense foods in addition to the lean beef, and this combination, together with the lower saturated fat content of the diets, likely explains the observed lipid-lowering effects. It remains unclear, however, whether a free-living population would be able to follow this dietary pattern over the long term.

Two other trials conducted in free-living populations have also shown that DASH diets including lean red meat (beef or pork) improve blood pressure. Sayer et al. (49) observed that blood pressure was lowered to a similar extent with a DASH diet that included 55% of total protein from lean pork compared with a DASH diet that included the same amount of protein from lean chicken and fish after 6 wk in healthy men and women with hypertension. Similarly, a DASH diet containing lean red meat (six 100-g servings/wk) was more effective at lowering blood pressure in postmenopausal women after 14 wk than a healthy reference diet (50). However, it should be noted that the healthy reference diet in this study included <2 servings red meat/wk, less fruit and vegetables, and more fats and oils, refined carbohydrates, and sodium than the DASH group. Therefore, it is likely that the blood pressure–lowering effects observed in the study by Nowson et al. (50) was due to the higher fruit and vegetable consumption and lower sodium intake in the DASH group compared with the reference diet.

Current Population Consumption and Adherence to Dietary Guidelines

Epidemiologic research shows that higher meat consumption is associated with lower consumption of nutrient-dense foods, particularly fruit, vegetables, legumes, nuts, seeds, and soy products. However, data from controlled-feeding studies show that when lean red meat is consumed as part of a dietary pattern that meets food-based dietary recommendations and limits saturated fat, sodium, and added sugar, risk factors for CVD are improved. Therefore, rather than focusing on the contribution of single foods or dietary components in isolation, the totality of the diet should be considered. Ultimately, there are multiple dietary patterns that are healthful and individuals should choose the one they can follow long term. In the 2015–2020 Dietary Guidelines for Americans, 3 dietary patterns are included: the healthy US-style diet, the healthy Mediterranean-style eating pattern, and the healthy vegetarian eating pattern (4). Each of these dietary patterns meets nutrient requirements, although the foods recommended in each differ, albeit slightly. Identifying dietary patterns that are associated with better cardiometabolic health is not the challenge; rather, improving population adherence to healthful dietary patterns is the obstacle.

Current data show that population consumption patterns markedly diverge from recommendations for cardiometabolic disease prevention (51). In the United States, the consumption of vegetables, fruit, dairy products, legumes, whole grains, and seafood is far lower than recommended. In addition, intakes of meats, poultry, eggs, refined grains, solid fats, added sugar, and sodium are much higher than recommended. In quantitative terms, the average intake of fruit and vegetables is 115 and 183 g/d, respectively (52), whereas 300 g fruit/d and 400 g vegetables/d are recommended (4). Similarly, intakes of nuts and seeds (~12 g/d) and whole grains (21 g/d) are well below recommended amounts of ~20 g/d (5 ounces/wk) and 125 g/d, respectively (4, 52). In comparison, Americans consume ~47 g unprocessed red meat/d and 31 g processed meat/d, whereas evidence shows that the lowest risk of cardiometabolic disease is observed when red meat consumption is <100 g/wk (14 g/d), and processed meat should not be consumed (4, 52). Furthermore, 90% of individuals in the United States consume discretionary foods on a daily basis; and among consumers, the average intake of discretionary food items is ~500 kcal/d or one-quarter of total energy intake (53). This shows that to improve overall adherence to the dietary guidelines and diet quality there needs to be a shift in consumption patterns to include more nutrient-dense foods and less "empty calorie" foods, which are high in calories, added sugar, refined carbohydrates, and solid fats. In total, the current US diet is high in energy-dense, nutrient-poor foods and low in fruit, vegetables, whole grains, legumes, nuts, and seeds.

The Dietary Guidelines Advisory Committee (2015) identified the following nutrients as being underconsumed in the United States: vitamin A, vitamin D, vitamin E, vitamin C, folate, calcium, magnesium, fiber, and potassium (54). For adolescent females and premenopausal women, iron is also an underconsumed nutrient. Plant-based foods are good sources of many of these shortfall nutrients, although dairy products and lean meat are high in calcium and iron, respectively. This further indicates that the consumption of fruit, vegetables, nuts, seeds, and whole grains needs to increase and replace nutrient-poor food choices.

Achieving Healthful Dietary Patterns

Many factors influence what foods an individual chooses to consume and their overall dietary pattern. Thus, to achieve meaningful changes in population dietary habits there needs to be intervention at the individual level, but health system changes and strong public policy are also required (16). A recent meta-analysis showed that a 10% price decrease (i.e., a subsidy) on healthy foods increased consumption by 12% (95% CI: 10%, 15%), and a 10% price increase (i.e., a tax) in the cost of unhealthy foods reduced consumption by 6% (95% CI: 4%, 8%) (55). Afshin et al. (55) also showed that reducing the price of fruit and vegetables by 10% increased consumption by 14% (95% CI: 11%, 17%). The American Heart Asssociation cites level 1A evidence for economic incentives that lower the cost of more healthy foods and beverages and level 2B evidence for increasing the price of unhealthy foods (56). In addition, cost-effectiveness modeling based on the Australian population showed that taxes and subsidies on foods and beverages are effective ways to improve population health and reduce health care expenditures (57). Other ways to improve population dietary intake are as follows: media and education strategies, mandated nutritional labeling and front-of-pack labeling, interventions targeted at schools and workplaces, increased availability of healthy foods and reduced prevalence of food deserts, regulation of food marketing and advertising to children, and regulation of food industry endorsement and sponsorship of children's sporting and leisure activities (56). Many of these strategies target the food industry to encourage reformulation and development of healthier products; thus, the role of the food industry must be considered in public health efforts to improve diet quality (58).

An example of how the food industry can influence population intake is the change in *trans* fat content in food products in response to the FDA-mandated labeling of *trans* fat on the Nutrition Facts panel (59). In 2006, the FDA introduced this mandate and, since this time, there has been a reduction in the *trans* fat content of the food supply (60, 61). In 2013, the FDA further determined that partially hydrogenated vegetable oils were no longer "generally recognized as safe" (62), which means that food manufacturers will no longer be able to use partially hydrogenated vegetable oil in their products, further reducing *trans* fat content in the food supply. The UK salt reduction program is another example of how product reformulation by the food industry can influence population intake and health outcomes. The UK salt reduction program had many components, but notably engaged the food industry and specific salt targets were set for product categories, with clear time frames for the targets to be achieved (63). The initiative was voluntary, with the threat of legislation, and companies that achieved the targets were praised and those that did not were publicly named and shamed. In the United Kingdom, salt intake was reduced from 9.5 g/d in 2001 to 8.6 g/d in 2008, and by a further 0.5 g (6%) to 8.1 g/d in 2011 (63, 64). It has been estimated that, as a result of this salt reduction program, there are 9000 fewer cardiovascular deaths per year in the United Kingdom (63).

The Role of RDNs in Improving Population-Level Dietary Intake

There is evidence of marked benefits to the food supply and the overall diet of the population as a result of policy interventions. RDNs can work to improve the overall food environment by advocating for stronger public health policies while also influencing dietary consumption patterns at the individual level. At an individual level, RDNs help patients and clients follow a dietary pattern that suits their specific needs and meets nutrient requirements. This individualized dietary prescription may also include education about recipe modification and cooking methods to achieve recommended intakes of foods and nutrients on the basis of specific needs. There is also a role for RDNs in influencing population health by advocating for healthy food environments, which may involve communicating with legislators, elected officials, and others who influence policy and legislation (65). Furthermore, when new policies or guidelines are introduced, RDNs can help to communicate the changes to individuals and the general public. RDNs can also work to translate research findings into practice. A recent systematic review that aimed to determine how nutrition-related evidence for the prevention and treatment of CVD is translated into practice showed that there are few data on how dietary knowledge is being translated to users (66). This is likely due to limited reporting of methods used to translate nutrition knowledge into practice rather than a lack of translation altogether. However, detailed and accurate reporting of the effectiveness of the different methods used to translate nutrition knowledge into practice is needed to facilitate successful, timely translation of research findings. Because RDNs work in many settings, including health care, the community, food service, industry, and research, they are uniquely positioned to facilitate the translation of evidence-based nutrition research into clinical practice and population-based strategies to achieve sustainable improvements in dietary consumption patterns (67).

Conclusions

Epidemiologic evidence suggests that plant-based diets are associated with a lower risk of cardiometabolic disease and that individuals with higher meat intakes are at greater risk of CVD; however, it is unclear whether this relation is indicative of a causative effect or due to other diet and lifestyle factors that differ between high- and low-meat consumers. Nonetheless, these studies show that small increases in plant-based foods reduce CVD risk. Data from randomized controlled trials with hard endpoints are not available, but well-controlled studies of intermediate outcomes have shown that nutrient-dense diets that contain animal protein, including some unprocessed lean meat, do not have adverse effects and may improve risk factors for CVD. Therefore, it is likely that the consumption of animal products (excluding processed red meats) at recommended amounts in the context of a dietary pattern that meets recommendations for fruit, vegetables, whole grains, nuts, seeds, and legumes and does not exceed recommendations for added sugar, sodium, and saturated fat may not adversely affect, and may benefit, cardiometabolic risk. However, population adherence to these recommendations is markedly suboptimal. Therefore, improving intake patterns to align with dietary guidelines should be the focus of our efforts rather than engaging in debate about whether diets for cardiometabolic disease prevention should be exclusively plant-based or include animal foods in recommended amounts. This will require that RDNs intervene at both the individual and population levels and also advocate for public policy that will effectively create healthier food environments.

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