Building better guidelines for healthy and sustainable diets

Walter C Willett,[1,2] *Frank B Hu,*[1,2] *Eric B Rimm,*[1,2] *and Meir J Stampfer*[1,2]

[1]Departments of Nutrition and Epidemiology, Harvard TH Chan School of Public Health, Boston, MA, USA; and [2]Channing Division of Network Medicine, Department of Medicine, Harvard Medical School, Boston, MA, USA

In December 2020, the USDA and US Health and Human Services (HHS) department issued the 2020–25 Dietary Guidelines for Americans (DGA) (1), completing a lengthy process involving a review of procedures by the National Academies of Sciences, Engineering, and Medicine (NASEM) (2), review of evidence by the 2020 US Dietary Guidelines Advisory Committee (DGAC) (3), and the in-house preparation of the final DGs by HHS and USDA. We recognize the massive, uncompensated effort for nongovernment employees, and that most of the guidance based on solid evidence accumulated over previous reviews was retained. Further, valuable new guidance was provided for young children. Despite these achievements, some key recommendations in the current DGA do not reflect the best available evidence, and the recommended intakes for food groups are not optimally healthy or environmentally sustainable. Human diets are inextricably interwoven with planetary health. Globally, 20–30% of greenhouse gas emissions are from agriculture (4); in the United States the percentage from the food system is lower at ∼15% (5), mainly due to large amounts of fossil fuels used for other purposes. Even assuming adoption of all green energy, current dietary patterns will likely prevent us from limiting global warming to under 2°C (6).

Here we describe our concerns about the specific shortcomings of the recommendations and the processes by which they were derived with the hope that these can be improved.

Added Sugar, Sugar-Sweetened Beverages, and Alcoholic Beverages

The DGA did not incorporate the DGAC recommendations to reduce the upper limit for added sugar from 10% to 6% of daily energy intake, and to reduce the limit of alcohol intake for men from 2 to 1 drink/d. Specification of an upper limit on added sugars is important, and we concur with the 6% limit suggested by the DGAC. However, explicitly targeting soda and other sugar-sweetened beverages (SSBs) for reduction would be most useful. These beverages are the largest source of added sugars in the diet (3), add little or no nutrient value, and evoke weaker satiety compared with solid foods (3). Also, much of the evidence for a limit on added sugar is actually based on studies of SSBs. Compelling evidence from prospective cohort studies and intervention trials documents that higher intakes of SSBs contribute to weight gain and obesity in both children and adults (7) and to a higher incidence of type 2 diabetes and dental caries. In particular, 2 of the largest and most rigorously conducted randomized controlled trials in children and adolescents found significant adverse effects of SSBs on body weight and adiposity (8, 9). In a meta-analysis of 17 prospective cohort studies, each 1 serving/d increment in SSB was associated with an 18% higher risk of type 2 diabetes (95% CI: 9, 28%) in studies that did not adjust for adiposity, and a 13% higher risk (95% CI: 6, 21%) in those that did, suggesting a partial mediating role of adiposity in this association (10). Similarly, in a meta-analysis of prospective cohort studies, higher consumption of SSBs robustly predicted greater risk of cardiovascular disease incidence and mortality (11), also in part mediated through weight gain. The adverse effects of SSBs on risk factors for cardiometabolic disease provide evidence that these associations are likely to be causal (12).

Guidance based on foods and beverages is easier for the public and professionals to understand and implement than using only nutrient limits. Whether the obfuscation was intended or not, few will appreciate that drinking even one 20-ounce soda (∼240 calories from sugar) exceeds the 10% limit for added sugars for most people. This clarity was incorporated in the new guidelines for children aged <2 y, but limits on both SSBs and added sugar should be included in guidelines for all ages.

In contrast to added sugar, we concur with HHS and USDA for bringing forward the 2015–2020 recommendations for alcohol consumption and not heeding the advice of the DGAC to reduce the limit to 1 drink/d for men. The new guideline now reads that those who choose to drink should limit intake to ≤1 drink/d for women and 2 drinks/d for men. This has been the most consistent

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Address correspondence to WCW (e-mail: wwillett@hsph.harvard.edu; walter.willett@channing.harvard.edu).
Abbreviations used: DG, Dietary Guideline; DGA, Dietary Guidelines for Americans; DGAC, Dietary Guidelines Advisory Committee; HHS, Health and Human Services; NASEM, National Academies of Sciences, Engineering, and Medicine; SSB, sugar-sweetened beverage.
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guideline since the inception of the DGs in 1980 and is supported by 5 decades of solid experimental studies and observational epidemiology. The recent DGAC review of alcohol was limited in scope and did not adhere to the stated process for evaluation of the totality of evidence, especially new evidence that would lead to a change in this stalwart guideline. Instead of a comprehensive review, they focused on the known adverse effects of excessive intake and on the few studies since 2010 that included "moderate drinkers" but did not discriminate between the adverse effects of heavy episodic drinking and the beneficial associations with more frequent moderate consumption. The DGAC did highlight the limitations of recent studies that could not differentiate risk by drinking patterns and that had only a single measure of baseline average alcohol intake with many decades of follow-up.

Major Protein Sources and Dietary Patterns

Although the DGA briefly acknowledge the healthfulness of the Mediterranean and vegetarian dietary patterns, the recommended intakes of specific foods across the life cycle exclude these dietary patterns as the recommendations support a heavily animal-based, US-style pattern. For example, for adults consuming 2400 kcal/d, the recommended intake for meat and eggs is 31 oz/wk, and for nuts, seeds, and soy foods is merely 5 oz/wk (both about current average US intakes). Further, 3 servings/d of dairy foods are recommended (almost double current intakes), and together with 2 servings/wk of fish, amount to ∼4–5 servings/d of animal-sourced foods. For recommended protein-rich foods, the DGs lead with "lean meat," putting plant protein sources far down the list.

Abundant evidence from randomized dietary studies with risk factors as outcomes, and from prospective epidemiological studies with clinical outcomes, supports intake of healthful plant-based protein sources in preference to animal sources. For example, in a meta-analysis of randomized trials, plant protein sources such as nuts, legumes, and soy foods reduced LDL cholesterol compared with red meat (13). In a network meta-analysis of 66 randomized trials examining effects of foods on blood lipids, blood pressure, indicators of glucose homeostasis, and inflammatory factors (14), nuts and legumes led the list for healthfulness whereas red meat, eggs, dairy foods, and SSBs were at the bottom. This evidence based on physiological effects of protein sources is consistent with compelling evidence from prospective epidemiological studies documenting that the Mediterranean dietary pattern, which emphasizes plant foods and low intakes of red meat and dairy foods, is associated with lower risks of many health outcomes including cardiovascular disease, cancer, type 2 diabetes, neurodegenerative disease, and total mortality (15). Also, in studies of specific foods, red meat has been associated with higher risk of major health outcomes, in contrast to the robust evidence documenting inverse associations for nuts and legumes (16, 17). Further, in substitution analyses estimating the effect of replacing red meat with other foods, intakes of healthy plant protein sources have been associated with lower risks of type 2 diabetes (18), coronary heart disease, and total mortality (19). Although processed red meat might be worse than unprocessed, both contribute to higher risk, and there is no clear evidence that lean red meat is better. Also, different forms of vegetarian diets have been associated with lower risks of obesity, diabetes, and coronary heart disease (20). Together, these data strongly support shifting toward lower consumption of animal protein sources, and higher intakes of healthy plant sources of protein than recommended by the DGA and current US intakes.

No persuasive evidence supports the DGA recommendation to nearly double dairy food intake compared with current average consumption. The basis of this recommendation derives primarily by considering dairy foods as a delivery vehicle for micronutrient intake to reach the DRIs, especially for calcium, which is 1200 mg/d for older adults. However, as noted elsewhere, the DRIs for calcium are based on balance studies lasting just a few weeks (21), which is far too short to represent long-term calcium balance. In contrast, the UK adequate intake is 700 mg/d. Among adolescent males with calcium intake <800 mg/d, at high demand for calcium due to rapid growth, increasing milk intake to 3 servings/d for 18 mo had no effect on measurements of bone health (22). Similarly, women with high consumption of milk during adolescence had no reduction in later-life risk of hip fractures, whereas in men a higher risk was seen (23). In long-term epidemiological studies, there is no clear overall evidence that high dairy food intake reduces risk of cardiovascular disease or total mortality (24). Higher intakes of dairy foods have been associated with lower risk of colorectal cancer (25), apparently due to the calcium content, but higher risk of prostate cancer (26). Some evidence suggests that yogurt can reduce risks of obesity and type 2 diabetes. However, the DGA recommendation for high intakes of dairy foods at twice the current average is not well supported.

Diets and Climate Change

Most important, the DGA are completely silent on their implications for climate change and other environmental consequences. This is a matter of great urgency because global warming has greatly accelerated over the last several decades, and we are now on track to substantially exceed the United Nations limit of 2°C warming by 2100, beyond which global systems will be severely and potentially irreversibly destabilized (27). Language inserted into a federal appropriations bill, purportedly due to lobbying by the beef industry, barred the USDA from any mention of the environmental consequences in the 2015 DGs (28). The 2015 report of the DGAC included a chapter on this topic, but this was ignored in the final DGs and the committee was admonished for this effort (29). Members of the DGAC separately published their review on this topic and concluded that diets lower in animal-sourced foods such as the Mediterranean diet and vegetarian dietary patterns have lower environmental impact than current Western diets high in animal-sourced foods (30). The 2020 DGAC cannot be faulted for excluding this topic from their report because any mention of climate change would have been unlikely to survive final approval (31).

The greenhouse gas emissions per serving of beef are approximately 150 times greater than for plant protein sources such as nuts and legumes; dairy foods and pork are ∼30–40 times higher (32). Much of this is due to the highly inefficient conversion by these animals of grain into human food, but the generation of methane in the rumen of cattle adds to the greenhouse gas emissions from production of beef and dairy foods. Compared to an animal-centric dietary pattern consistent with the DGA recommendations, greenhouse gas emissions are reduced by ∼30% with adoption of a Mediterranean diet pattern,

and by ∼55% with a vegetarian diet (32). Important differences are also seen for other environmental impacts such as water and land use, pollution by phosphorus and nitrogen, and species extinction (6, 32). The EAT-Lancet Commission identified a healthy and sustainable dietary pattern, similar to the traditional Mediterranean diet, that was mainly plant-based but included ∼2 servings/d of animal-sourced foods, one being dairy foods and the other being a combination of fish, poultry, eggs, and red meat. Using 3 different methods, adoption of this dietary pattern was estimated to prevent 19–24% of premature deaths globally (6). In sensitivity analyses, increasing dairy foods from 1 to 2 servings/d or increasing red meat only modestly would exceed planetary boundaries; thus, the recommendations of the DGs are clearly environmentally unsustainable.

The new DGs recommend low-fat dairy foods and lean meats, but fail to consider the fate of the remaining fat. If these fats are discarded or burned, this would add greatly to food waste and environmental impacts. More likely, because they have value, they are skimmed off and made into cream, butter, and other highly saturated fat foods and unfortunately end up in the diets of groups that are already at high risk of noncommunicable diseases. A better approach would be simply to limit, but not necessarily eliminate, dairy foods and meat to the modest amounts consistent with the EAT-Lancet targets, and instead emphasize plant-based alternatives to dairy and meat.

The Process of Developing DGs

The inconsistency between the emphasis on animal sources of proteins in the 2020 DGA recommendations and the weight of evidence on health effects raises questions about the entire process for developing them. The process for developing the guidelines was improved by additional incorporation of systematic reviews and in other ways. However, we suggest the following:

1) Because human and planetary health are tightly intertwined, the DGAC should be charged with reviewing evidence on both the direct effects of diet on health and the effects of diet on planetary health; this information should be incorporated into the DGA. We should not wait another 5 y to address this issue; the HHS and USDA should immediately either use the 2015 DGAC report or have the NASEM review evidence on diets and climate change to inform policies and communications.

2) Rather than simply be told what issues they should review evidence for, the DGAC members should play a primary role in identifying these key issues; HHS and USDA could also identify issues for which review is needed, but theirs should not be the only voice in this process. Specifically, these issues should include identification of optimal ranges for specific foods and food groups that collectively lead to overall dietary patterns that best support both human and planetary health.

3) The reliance on DRIs to develop dietary recommendations, which considers foods as delivery vehicles for essential nutrients, should be limited, because the effects of foods on health cannot be judged solely by their content of essential nutrients, and because the DRIs are often based on short-term studies, are not regularly updated, and are often inherently imprecise (33). A check of dietary patterns against DRIs is reasonable, but the overall relation of foods and dietary patterns to health should take priority.

4) Systematic reviews are an invaluable part of the process to ensure that all available evidence is considered, but meta-analyses have major limitations due the heterogeneity of exposures and outcomes and because they can only use information that is in common across studies. Thus, they can be misleading despite the veneer of providing a comprehensive assessment, and need to be considered together with the primary literature and deep knowledge of the topic. The rationale for conclusions about systematic reviews should be transparent.

5) Although the life course approach in developing the DGA is important, the detailed modeling of recommendations for specific age and sex groups beyond young children, which occupies a large part of the DG report, could be greatly reduced because there is huge overlap in these groups related to variation in body size and physical activity. This implies precision that is not realistic, and it distracts from the importance of overall dietary patterns that need not differ appreciably from later childhood to later life, although specific components can be adapted to individual characteristics.

By using many sources of evidence and incorporating the insights of many people, the DGs have improved over the years, and improvements in diet have contributed to the major gains in life expectancy over the last 60 y. However, relentless epidemics of obesity and diabetes are contributing to reductions in life expectancy, and we are on track to severely damage the ecosystem. Thus, we urgently must change the foods we eat and how we produce them. This urgency has been heightened by the COVID-19 pandemic, outcomes of which are made worse by poor diet quality and obesity. The 2020 dietary recommendations, which are still animal food-centric and would require a massive increase in dairy production, along with additional fruits and vegetables (including a doubling of starch vegetables), are not sufficient to address these challenges. We hope our suggestions will help in the quest for diets and food systems that support better health for all and a healthy planet that can be passed on to future generations.

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References

1. U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary guidelines for Americans, 2020–2025. 9th ed. USDA; 2020.
2. National Academies of Sciences, Engineering, and Medicine. Redesigning the process for establishing the Dietary Guidelines for Americans. Washington (DC): The National Academies Press; 2017.
3. Dietary GAC. Scientific report of the 2020 Dietary Guidelines Advisory Committee: advisory report to the Secretary of Agriculture and the Secretary of Health and Human Services. Washington (DC): US Department of Agriculture, Agricultural Research Service; 2020.
4. Vermeulen SJ, Campbell BM, Ingram JSI. Climate change and food systems. Annu Rev Environ Resour 2012;37:195–222.

5. Hitaj C, Rehkamp S, Canning P, Peters CJ. Greenhouse gas emissions in the United States food system: current and healthy diet scenarios. Environ Sci Technol 2019;53:5493–503.
6. Willett WC, Rockstrom J, Loken B, Springmann M, Lang T, Vermeullen S, Garnett T, Tilman D, DeClerck F, Wood A, et al. Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems: Lancet 2019;393:447–92.
7. Malik VS, Hu FB. Sugar-sweetened beverages and cardiometabolic health: an update of the evidence. Nutrients 2019;11:1840.
8. de Ruyter JC, Olthof MR, Seidell JC, Katan MB. A trial of sugar-free or sugar-sweetened beverages and body weight in children. N Engl J Med 2012;367:1397–406.
9. Ebbeling CB, Feldman HA, Chomitz VR, Antonelli TA, Gortmaker SL, Osganian SK, Ludwig DS. A randomized trial of sugar-sweetened beverages and adolescent body weight. N Engl J Med 2012;367:1407–16.
10. Imamura F, O'Connor L, Ye Z, Mursu J, Hayashino Y, Bhupathiraju SN, Forouhi NG. Consumption of sugar sweetened beverages, artificially sweetened beverages, and fruit juice and incidence of type 2 diabetes: systematic review, meta-analysis, and estimation of population attributable fraction. Br J Sports Med 2016;50:496–504.
11. Yin J, Zhu Y, Malik VS, Li X, Peng X, Zhang FF, Shan Z, Liu L. Intake of sugar-sweetened and low-calorie sweetened beverages and risk of cardiovascular disease: a meta-analysis and systematic review. Adv Nutr 2021;12:89–101.
12. Te Morenga LA, Howatson AJ, Jones RM, Mann J. Dietary sugars and cardiometabolic risk: systematic review and meta-analyses of randomized controlled trials of the effects on blood pressure and lipids. Am J Clin Nutr 2014;100:65–79.
13. Guasch-Ferre M, Satija A, Blondin SA, Janiszewski M, Emlen E, O'Connor LE, Campbell WW, Hu FB, Willett WC, Stampfer MJ. Meta-analysis of randomized controlled trials of red meat consumption in comparison with various comparison diets on cardiovascular risk factors. Circulation 2019;139:1828–45.
14. Schwingshackl L, Schwedhelm C, Hoffmann G, Lampousi A-M, Knüppel S, Iqbal K, Bechthold A, Schlesinger S, Boeing H. Food groups and risk of all-cause mortality: a systematic review and meta-analysis of prospective studies. Am J Clin Nutr 2017;105:1462–73.
15. Dinu M, Pagliai G, Casini A, Sofi F. Mediterranean diet and multiple health outcomes: an umbrella review of meta-analyses of observational studies and randomised trials. Eur J Clin Nutr 2018;72:30–43.
16. Qian F, Riddle MC, Wylie-Rosett J, Hu FB. Red and processed meats and health risks: how strong is the evidence? Diabetes Care 2020;43:265–71.
17. Micha R, Shulkin ML, Penalvo JL, Khatibzadeh S, Singh GM, Rao M, Fahimi S, Powles J, Mozaffarian D. Etiologic effects and optimal intakes of foods and nutrients for risk of cardiovascular diseases and diabetes: systematic reviews and meta-analyses from the Nutrition and Chronic Diseases Expert Group (NutriCoDE). PLoS One 2017;12:e0175149.
18. Wurtz AML, Jakobsen MU, Bertoia ML, Hou T, Schmidt EB, Willett WC, Overvad K, Sun Q, Manson JE, Hu FB, et al. Replacing the consumption of red meat with other major dietary protein sources and risk of type 2 diabetes mellitus: a prospective cohort study. Am J Clin Nutr 2021;113:612–21.
19. Zheng Y, Li Y, Satija A, Pan A, Sotos-Prieto M, Rimm E, Willett WC, Ju FB. Association of changes in red meat consumption with total and cause specific mortality among US women and men: two prospective cohort studies. BMJ 2019;365:l2110.
20. Papier K, Appleby PN, Fensom GK, Knuppel A, Perez-Cornago A, Schmidt JA, Tong TYN, Key TJ. Vegetarian diets and risk of hospitalisation or death with diabetes in British adults: results from the EPIC-Oxford study. Nutr Diabetes 2019;9:7.
21. Willett WC, Ludwig DS. Milk and health. N Engl J Med 2020;382:644–54.
22. Vogel KA, Martin BR, McCabe LD, Peacock M, Warden SJ, McCabe GP, Weaver CM. The effect of dairy intake on bone mass and body composition in early pubertal girls and boys: a randomized controlled trial. Am J Clin Nutr 2017;105:1214–29.
23. Feskanich D, Bischoff-Ferrari HA, Frazier AL, Willett WC. Milk consumption during teenage years and risk of hip fractures in older adults. JAMA Pediatr 2014;168:54–60.
24. Guo J, Astrup A, Lovegrove JA, Gijsbers L, Givens DI, Soedamah-Muthu SS. Milk and dairy consumption and risk of cardiovascular diseases and all-cause mortality: dose-response meta-analysis of prospective cohort studies. Eur J Epidemiol 2017;32:269–87.
25. Aune D, Chan DS, Greenwood DC, Vieira AR, Navarro Rosenblatt DA, Vieira R, Norat T. Dietary fiber and breast cancer risk: a systematic review and meta-analysis of prospective studies. Ann Oncol 2012;23:1394–402.
26. Aune D, Navarro Rosenblatt DA, Chan DS, Vieira AR, Vieira R, Greenwood DC, Vatten LJ, Norat T. Dairy products, calcium, and prostate cancer risk: a systematic review and meta-analysis of cohort studies. Am J Clin Nutr 2015;101:87–117.
27. Tollefson J. How hot will Earth get by 2100? Nature 2020;580:443–5.
28. H.R.2029 - Consolidated Appropriations Act, 2016.
29. Hagstrom Report. Vilsack likens dietary guidelines committee to 3-year-old [Internet]. 2015 [cited March 28, 2021]. Available from: https://www.hagstromreport.com/2015news_files/2015_0227_vilsack-likens-dietary-guidelines-committee-3-year-old.html.
30. Nelson ME, Hamm MW, Hu FB, Abrams SA, Griffin TS. Alignment of healthy dietary patterns and environmental sustainability: a systematic review. Adv Nutr 2016;7:1005–25.
31. Milman O. US federal department is censoring use of term 'climate change', emails reveal. The Guardian. 2017 Aug 7.
32. Tilman D, Clark M. Global diets link environmental sustainability and human health. Nature 2014;515:518–22.
33. Bier DM, Willett WC. Dietary Reference Intakes: resuscitate or let die? Am J Clin Nutr 2016;104:1195–6.