Can We Say What Diet Is Best for Health?

D.L. Katz[1,2] and S. Meller[2]

[1]Prevention Research Center, Yale University School of Public Health, Griffin Hospital, Derby, Connecticut 06418; email: david.katz@yale.edu

[2]Yale University School of Medicine, New Haven, Connecticut 06510

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Abstract

Diet is established among the most important influences on health in modern societies. Injudicious diet figures among the leading causes of premature death and chronic disease. Optimal eating is associated with increased life expectancy, dramatic reduction in lifetime risk of all chronic disease, and amelioration of gene expression. In this context, claims abound for the competitive merits of various diets relative to one another. Whereas such claims, particularly when attached to commercial interests, emphasize distinctions, the fundamentals of virtually all eating patterns associated with meaningful evidence of health benefit overlap substantially. There have been no rigorous, long-term studies comparing contenders for best diet laurels using methodology that precludes bias and confounding, and for many reasons such studies are unlikely. In the absence of such direct comparisons, claims for the established superiority of any one specific diet over others are exaggerated. The weight of evidence strongly supports a theme of healthful eating while allowing for variations on that theme. A diet of minimally processed foods close to nature, predominantly plants, is decisively associated with health promotion and disease prevention and is consistent with the salient components of seemingly distinct dietary approaches. Efforts to improve public health through diet are forestalled not for want of knowledge about the optimal feeding of *Homo sapiens* but for distractions associated with exaggerated claims, and our failure to convert what we reliably know into what we routinely do. Knowledge in this case is not, as of yet, power; would that it were so.

INTRODUCTION

Dietary pattern is among the most fundamentally important of health influences (46, 54, 60–62, 81, 139, 145). The full scope of health effects, both good and bad, attributable to all variations on the theme of dietary pattern defies calculation because of the complexities of the causal pathway. In contrast, physical activity, the one other exposure of comparably universal importance, constitutes a relatively simpler variable, facilitating an at least rough approximation of the quantitative effects of sedentariness on global health (103). The overall effects of diet are thought to be at least comparable.

Over the past two decades in particular, since McGinnis and Foege published their seminal paper, "Actual Causes of Death in the United States," in the *Journal of the American Medical Association* (114), the peer-reviewed literature has emphasized the influence of dietary pattern, in the context of a short list of other lifestyle factors, on what may be referred to as medical destiny—the combination of years of life (longevity) and life in years (vitality). That feet (physical activity), forks (dietary pattern), and fingers (tobacco use) are the master levers of medical destiny has been a theme in the medical literature ever since (4, 46, 50, 55, 56, 96, 100, 113, 119, 161). A comparable array of lifestyle factors has been shown to exert a decisively favorable influence on gene expression as well (58, 105, 129), arguing for the epigenetic importance of diet and other behaviors, and the potential to nurture nature through an application of lifestyle as medicine (90).

As reported recently by the Institute of Medicine (67), in the United States, a lifestyle pattern at odds with health—inclusive of, but not limited to, poor dietary choices—is linked to a growing disparity between life span, the length of life per se, and healthspan, defined as years of healthy life. Globally, lifestyle-related chronic diseases constitute an enormous and growing burden (59).

In this context, against the backdrop of hyperendemic obesity and epidemic diabetes, and given the enormously lucrative market for weight loss and health-promotion diets (137), claims for the decisive superiority of one diet over others abound. This review examines the more prominent of such claims and attempts to generate a useful and actionable answer to one basic question: Can we say what diet is best for health?

OVERVIEW OF DIETARY PATTERNS AND HEALTH

Potential ways to characterize dietary patterns, inclusive of minor variations on particular themes, are innumerable, and a very large number of such diets are in use by someone, somewhere. To the authors' knowledge, there is no single prevailing inventory that most efficiently codifies major subtypes for purposes of comparative review. Such a construct is useful here for efficiency, if not essential to interpretation, and therefore an organizing scheme is proposed and summarized in **Table 1**.

LOW-CARBOHYDRATE DIETS

There is no single authoritative definition of a low-carbohydrate diet, and in the absence thereof, such diets are generally defined by their common focus—namely, restricting intake of total carbohydrate below some particular threshold. A reasonable, operational definition may be derived from the Dietary Reference Intakes of the Institute of Medicine, which establish the recommended range for normal carbohydrate intake at between 45% and 65% of total calories (45). Total mean daily carbohydrate intake below 45% of total calories is therefore a low-carbohydrate diet.

Interest in carbohydrate-restricted diets is long-standing, particularly in the context of diabetes management, and especially during the era before the advent of insulin therapy (2, 44). Interest

Table 1 Basic varieties of dietary patterns[a]

Dietary pattern	Defining characteristics	Rationale
Low carbohydrate, including high protein, of either animal or plant origin	The particular focus is on the restriction of total carbohydrate intake from all sources below some threshold, reasonably set at the lower limit of the recommended range established by the Institute of Medicine, or 45% of daily calories.	Of recent and widespread interest and use; associated with a substantial literature; relates to one of the three macronutrient classes
Low fat, including vegetarian and traditional Asian	The particular focus is on the restriction of total fat intake from all sources below some threshold, reasonably set at the lower limit of the recommended range established by the Institute of Medicine, or 20% of daily calories. Vegetarian diets are mostly plant based but typically include dairy and eggs and may selectively include other animal products, such as fish and other seafood.	Of long-standing and widespread interest and use; associated with a very extensive research literature; relevant to large, free-living populations; encompasses a broad theme with many distinct variants; relates to one of the three macronutrient classes
Low glycemic	The particular focus is on limiting the glycemic load of the overall diet by restricting the intake of foods with a high glycemic index and/or glycemic load. This often extends to the exclusion of certain vegetables and many if not all fruits. No particular threshold value for glycemic load is consistently invoked.	Of widespread interest and use; directly relevant to diabetes and related conditions of considerable public health importance; associated with an extensive research literature; pertains to the quality of one of the macronutrient classes (the glycemic load may be considered a proxy measure of carbohydrate quality)
Mediterranean	The particular focus is on mimicking the common themes of the traditional dietary pattern that prevails in Mediterranean countries: an emphasis on olive oil, vegetables, fruits, nuts and seeds, beans and legumes, selective dairy intake, and whole grains; often fish and other seafood; and quite limited consumption of meat. Moderate wine intake is often explicitly included as well.	Of long-standing and widespread interest and use; relevant to large, free-living populations; representative of traditional ethnic and regional practice; associated with an extensive research literature; pertains in part to the quality of one of the macronutrient classes (Mediterranean diets are often viewed as emphasizing healthful fat)
Mixed, balanced	This category refers generally to diets that include both plant and animal foods and conform to authoritative dietary guidelines, such as the Dietary Reference Intakes of the Institute of Medicine, the Dietary Guidelines for Americans, and the Dietary Recommendations of the World Health Organization.	Of long-standing and widespread interest and use; closest approximations of currently prevailing Western diets; associated with an extensive research literature, including intervention trials devised and conducted by the National Institutes of Health (e.g., DASH and DPP)
Paleolithic	The particular focus is on emulating the dietary pattern of our Stone Age ancestors, with an emphasis on avoiding processed foods and the preferential intake of vegetables, fruits, nuts and seeds, and lean meats. In principle at least, dairy and grains are excluded entirely.	An informed approximation of the native human diet; of growing, recent interest; associated with a substantial research literature; pertains in part to the quality of one of the macronutrient classes (Paleolithic diets are often viewed as emphasizing lean protein)
Vegan	These are diets that exclude all animal products, including dairy and eggs. In principle at least, all animal products are excluded entirely.	Of widespread interest and use; relevant to large, free-living populations; representative of traditional ethnic and regional practice; relevant to important public health considerations beyond individual human health, including ethics, animal husbandry, food-borne infections, and environmental sustainability; associated with an extensive research literature

(*Continued*)

Table 1 (*Continued*)

Dietary pattern	Defining characteristics	Rationale
Other	Not applicable	Some attention to a wide variety of dietary patterns that are less generalizable, and with a more idiosyncratic focus (e.g., gluten-free, calorie restriction, raw), is warranted given widespread, if periodic or temporary, attention in popular culture

Abbreviations: DASH, Dietary Approaches to Stop Hypertension; DPP, Diabetes Prevention Program.
[a]Although the proposed scheme is neither definitive nor entirely comprehensive, it captures the most important dietary variants based on real-world application; the volume of relevant literature; population-level and cultural relevance; and emphasis on the quantity or quality of one or more of the major macronutrient groups (i.e., protein, fat, and carbohydrate).

in low-carbohydrate eating resurged over recent decades, in the context of epidemic obesity and the pursuit of effective strategies for weight loss and weight control (77, 79, 80). In particular, low-carbohydrate advocacy has tended to emphasize the population-level failures of low-fat recommendations for weight control and chronic disease prevention (2). Such assertions are a valid appraisal of prevailing nutritional epidemiology but almost certainly misrepresent the underlying intentions of the dietary guidance in this case, and many others, as discussed below (86).

Intervention studies of short to moderate duration demonstrate the efficacy of low-carbohydrate diets for weight loss, with potentially beneficial metabolic effects and favorable implications for quality of life (19, 20, 32, 41, 52, 117, 144, 163, 165). Such studies cannot and do not, however, unbundle the effects of (*a*) carbohydrate restriction per se, on which the theory of the approach is predicated, and (*b*) calorie restriction, which is a virtually inevitable concomitant of choice restriction in general (80), and, perhaps especially, (*c*) restriction directed at carbohydrate, which constitutes the macronutrient class that provides the majority of calories for almost all omnivorous species (77). Carbohydrate-restricted diets are calorie restricted as well. In the absence of calorie restriction, high-protein, low-carbohydrate diets can contribute to weight gain and adverse metabolic effects (147). However, metabolic benefits of low-carbohydrate dieting under diverse circumstances have been reported (47, 73, 159).

This covariance of carbohydrate and calorie intake complicates the assessment of the metabolic effects of low-carbohydrate eating. Most relevant intervention studies involve weight loss, with attendant cardiometabolic benefits. If and when improvement in cardiometabolic biomarkers is induced by the acute phase of weight loss, the determination of specific concurrent effects of dietary pattern on those same indices is precluded. Low-carbohydrate eating may augment or attenuate the cardiometabolic benefits of the weight loss induced by caloric restriction. The relevant literature remains equivocal, with most studies suggesting benefit from low-carbohydrate eating per se in comparison, generally, to either the typical Western diet or some version of a low-fat diet, with persistent concerns and uncertainty about longer-term effects on health outcomes (18, 39, 95).

Low-carbohydrate diets, of necessity, shift dietary intake to relatively higher levels of fat and/or protein as a percentage of total calories. The literature addressing high-protein diets thus constitutes an extension of the low-carbohydrate theme. In the context of widespread obesity, protein is noteworthy for its high satiety index (14), and high-protein intake offers the potential benefits related to enhanced satiation.

Unlike others of the prominent dietary categories, low-carbohydrate eating is associated with quite limited population-level and cultural experience. One frequently cited exception is the Inuit diet (71). Although low in carbohydrate, the Inuit diet is by no means concordant with popular interpretations of low-carbohydrate eating, given its traditional focus on marine animals, including seal, whale, etc. The Inuit diet is exceptionally high in omega-3 fatty acids, which is not characteristic of most low-carbohydrate diets. Also of note, the Inuit do not have exceptional health or longevity and are especially subject, perhaps because of the high omega-3 fat intake, to intracranial hemorrhage (16). Another potential exception is the Paleolithic diet (see below), which is at times invoked as an illustration of low-carbohydrate eating; however, it is not truly low in carbohydrate and differs substantially from most popular versions of the low-carbohydrate diet. Finally, a recent prospective cohort study in a Swedish population may point to a rare exception: No increase in incident cancers over nearly 20 years of follow-up was observed in conjunction with relatively low-carbohydrate intake (123).

Whereas Robert Atkins and many disciples since have emphasized unrestricted intake of meat and dairy, newer versions of low-carbohydrate eating suggest limits to saturated fat intake and place a greater emphasis on considerations other than just carbohydrate content. The Atkins Diet itself has been reinvented to reflect such principles (8). Relevant evidence for assessing health effects is for the most part lacking. Given this trend toward redefinition of low-carbohydrate dieting, readers must be attentive to the details of any given study to avoid inappropriately generalizing the results relating to one dietary pattern to others that share a rubric but are compositionally quite distinct.

A relatively recent addition to this area of study is a low-carbohydrate dietary pattern based on high-protein plant rather than animal foods. This pattern, referred to by David Jenkins and colleagues as an eco-Atkins diet, has been associated with favorable effects on weight and cardiometabolic indices (70), although the relevant literature is limited. As the designation implies, such a diet might offer recourse to low-carbohydrate eating to those so inclined while mitigating the environmental impact and sustainability challenges of a diet predominated by animal foods.

Although the focus here is on health effects, a diet that cannot be generalized or sustained is unlikely to confer the greatest health benefits at the population level over time. In the absence of clear evidence that low-carbohydrate diets are more healthful than alternatives, their potential liabilities in other areas are noteworthy. An emphasis on meat is an inefficient basis for feeding a global population now in excess of seven billion. Ethical concerns have been raised about meat-eating in general (13) and in particular with regard to the treatment of animals associated with feeding multitudes, along with concerns about the environmental costs of heavily animal-based diets (68). These do not obviate consideration of low-carbohydrate diets when seeking personal health benefits, but they do provide relevant context for public health nutrition. The eco-Atkins construct is at least a useful illustration that high-protein diets, if not truly low-carbohydrate diets (see below), can be mostly plant based, potentially expanding the relevance of this dietary approach. There is, however, some research to show that some of the putative benefits of carbohydrate restriction may be achieved merely by choosing better carbohydrate sources, with attendant advantages (116).

A truly low-carbohydrate diet would be low in all sources of carbohydrate, including vegetables, fruits, whole grains, and, to a lesser extent, beans and legumes. Proponents of such diets generally note that the particular variant they favor does not limit vegetables or beans. Such diets are then not truly low carbohydrate but rather carbohydrate selective. Given that any healthful diet is carbohydrate selective, the distinction between low carbohydrate and alternative approaches is potentially much attenuated. In such a context, the evidence supporting health benefits of some degree of carbohydrate restriction with liberalization of protein and/or fat intake for at least short-term benefit is fairly strong and consistent.

In summary, weight loss studies of short to moderate duration suggest that carbohydrate restriction is at least as effective as any other approach. Studies relevant to health outcomes across the life span are lacking, representing not so much evidence of absent benefits but a relative absence of evidence.

LOW-FAT/VEGETARIAN DIETS

Low-fat diets imply a particular focus on the restriction of total fat intake from all sources below some threshold, reasonably set at the lower limit of the recommended range established by the Institute of Medicine (45), or 20% of daily calories. Vegetarian diets are mostly plant based, but typically they include dairy and eggs and may selectively include other animal products, such as fish and other seafood.

In contrast to the experience with low-carbohydrate diets, population-level experience with low-fat and either vegetarian or mostly plant-based dietary patterns is extensive. Among the populations famously associated with low-fat, mostly plant-based eating are such groups as the Okinawans and Seventh Day Adventists (see the section Vegan Diets, below). The diets of most primates are overwhelmingly plant based and low in total fat and are thought to be reflective of the earliest versions of the native human and prehuman diets, which evolved to include more meat in accord with hunting prowess (110).

Intervention trials have long shown benefits from dietary fat restriction, ranging from weight loss to improvements in various biomarkers to reductions in cardiac events and mortality. Low-fat, plant-based eating has been associated with reductions in cancer and cardiometabolic disease (7, 72). During recent years, there has been something of a backlash against low-fat eating recommendations because of the concomitant embrace of such recommendations and worsening of the obesity and diabetes epidemics. Data from the National Health and Nutrition Examination Survey (NHANES), however, suggest that dietary fat intake did not appreciably decline; rather, total calorie intake went up, with the increase due to the adoption of many high-starch, high-sugar, low-fat foods (24). The decline in the percentage of calories from fat was more attributable to increased calorie intake than to decreased fat intake. The intent of low-fat guidance was, presumably, to encourage consumption of naturally low-fat foods—namely, plant foods direct from nature, rather than highly processed, fat-reduced foods (86). Adverse effects of low-fat eating may be associated with this misapplication of the original guidance rather than the intended guidance per se.

Low-fat, plant-based eating has been shown to prevent recurrent myocardial infarction in adults with high risk (130), exerting a favorable effect comparable to although not decisively greater than that of a Mediterranean diet (37). Uniquely, a very-low-fat diet has been shown to cause regression of coronary atherosclerosis (128). One direct comparison of low-fat and low-carbohydrate diets demonstrated favorable effects of the low-fat diet on endothelial function, suggesting greater overall cardiac benefit (134).

A vegetarian diet is not reliably low in fat, nor does it necessarily comprise mostly wholesome plant foods. Similarly, a low-fat diet need not be high in plant foods, and it certainly need not comprise wholesome foods direct from nature. For purposes of this assessment, however, the more idealized versions of "low-fat" and "vegetarian" are intended. Such diets do tend to overlap, and both place a particular emphasis on wholesome, minimally processed, plant-derived foods.

When overly restrictive, vegetarian diets (and vegan diets, see below) can be associated with suboptimal nutritional status and adverse health effects (66). There is an association, as well, between vegetarian dietary patterns and eating disorders in certain populations (9), although the dietary pattern in such cases is more likely an effect of the underlying tendency toward disordered eating rather than a causal contribution to it. When attention is directed to nutritionally replete, low-fat, plant-based diets, the literature lends strong support for favorable effects across a wide array of health outcomes (5, 15, 84, 115, 133, 134, 146, 148).

When such is the case, this basic dietary category is associated with a relatively high intake of fiber from vegetables, fruits, whole grains, beans and legumes, and nuts and seeds. Numerous studies suggest health benefits from fiber intake well above the levels that prevail in the

United States, and the recommended fiber intake is well above the population mean intake (154). Although there is some doubt about the specific contribution insoluble fiber makes to defending against colon cancer, its general health benefit is well established. High intake of soluble fiber has been shown to mimic the lipid-modifying effects of pharmacotherapy (69). High-fiber intake at breakfast has been shown to blunt glycemic responses at lunch (104), and decisive benefits are associated with high-fiber intake by people with diabetes (25).

That said, there is no decisive evidence that low-fat eating is superior to diets higher in healthful fat in terms of health outcomes over the life span (see Mediterranean Diet section). When food choices are judicious in both contexts, the superiority of fat-restricted versus carbohydrate-restricted eating for weight loss and health is not reliably established (48, 63, 98).

Increasing attention is directed at the relative benefits of dietary fat modification, versus dietary fat restriction, encouraging limitations of harmful fat and more liberal intake of healthful fats. Efforts to elucidate the different mechanistic pathways of beneficial effects are evolving (157). Attention to the health effects of different classes of dietary fat is currently rather intense and represents a fast-developing area of the research literature.

One of the more controversial aspects of plant-based eating is the role of grains. Evidence is fairly strong for a generous intake of dietary fiber over the life span (156), with whole grains representing an important source. Advocacy for the inclusion of whole grains in the diet is widespread (153), but concerns about the contributions of grains to obesity have been expressed quite vocally (34), in particular concerns about the rising prevalence of gluten sensitivity (108) and concerns about genetic modifications of wheat (158).

Data from NHANES suggest that grain intake is related to positive nutrient profiles and improvement in chronic disease risk factors and is unrelated to obesity (64). The literature generally associates whole-grain intake with lower cancer risk, greater diet quality, and better control of body weight (101, 126, 140).

LOW-GLYCEMIC DIETS

The particular focus of low-glycemic diets is on limiting the overall dietary glycemic load by restricting the intake of foods with a high glycemic index and/or glycemic load. This often extends to the exclusion of certain vegetables and many if not all fruits, along with processed foods containing refined starches and/or added sugars. No particular threshold value for glycemic load is consistently invoked, however.

In an age of epidemic diabetes, attention to the glycemic effects of food is sensible at the least. Federal authorities have declined the incorporation of the glycemic index or glycemic load into population-level dietary guidance, citing the state of evidence (152). This position may pertain more to the challenges of measuring and communicating glycemic metrics than to the availability of trial data, however.

Clinical trial data are available and generally support efforts to reduce the glycemic load of the diet. Studies focused on this strategy have demonstrated benefits in the areas of weight loss, insulin metabolism, diabetes control, inflammation, and vascular function (108). Benefits have been seen in studies of both adults and children (118). Conversely, a high dietary glycemic load has been associated with adverse health effects. A recent meta-analysis concluded that high glycemic load and index are associated with increased risk of cardiovascular disease, especially for women (109).

Often absent from discussions of low-glycemic diets is the consideration that, as with other dietary categories, there are various means to the same ends. McMillan-Price et al. studied alternative approaches to achieving a reduced glycemic load (116) and demonstrated that a high-fiber, mostly plant-based approach offered metabolic advantages over a high-protein approach. By demonstrating that a high-carbohydrate, low-glycemic diet may offer particular cardiac benefit, the McMillan-Price study points to a diet in which choice within macronutrient categories is given at least as much consideration as choice among those categories.

In popular culture, concerns about the glycemic index have resulted in some very questionable dietary practices. Some vegetables, such as carrots, have a high glycemic index (although a low glycemic load) and were excluded from the recommended foods in certain popular diets (51). Most fruits are precluded by a preferential focus on the glycemic index as well. Evidence that health benefits ensue from jettisoning fruits, or relatively high-glycemic-index vegetables, from the diet does not exist.

Perhaps the single most important observation regarding low-glycemic eating is that it, too, tends to occur as a by-product of favoring minimally processed, direct-from-nature foods and avoiding refined starch and added sugars. This basic approach to achieving reduced glycemic load is compatible with all or nearly all of the other dietary approaches under consideration here.

MEDITERRANEAN DIETS

Mediterranean diets are based on the common themes of the traditional dietary pattern that prevails in Mediterranean countries: an emphasis on olive oil, vegetables, fruits, nuts and seeds, beans and legumes, selective dairy intake, and whole grains; often fish and other seafood; and quite limited consumption of meat. Moderate wine intake is often explicitly included as well (149).

Traditional Mediterranean diets, like traditional Asian diets, figure prominently in the recent body of work characterizing Blue Zones—regions and cultures around the world where lifestyle patterns, inclusive of traditional dietary approaches, have been associated with longevity and vitality (162). The Mediterranean diet, which is, of course, a range of dietary patterns differing by place and over time, offers the advantages of moderation, familiarity, palatability, and associations with pleasure as well as health. The salient, common features of the dietary pattern are as noted above. This pattern tends to result in favorable effects on the ratio of omega-6 and omega-3 essential fatty acids, high intake of fiber, and generous consumption of antioxidants and polyphenols (167). Overall, Mediterranean eating has been associated with increased longevity, preserved cognition, and reduced risk of cardiovascular disease in particular, with some evidence for reduced cancer risk (35–37, 43, 53, 65, 111, 124, 149). Longevity effects of diet, per se, are of course difficult if not impossible to unbundle from the effects of related lifestyle practices and cultural context, but given such limitations, Mediterranean dietary patterns have been associated with longevity.

The scientific support for variations on the theme of Mediterranean eating is very strong. Intervention trials, such as the Lyon Diet Heart Study (35), have demonstrated cardiovascular benefit at least as great as that seen with low-fat, vegetarian diets. PREDIMED (Effects of the Mediterranean Diet on the Primary Prevention of Cardiovascular Diseases), an international intervention trial assessing the effects of a Mediterranean diet on cardiovascular outcomes (141), and other trials have shown diverse health benefits. In systematic review, the Mediterranean diet showed favorable effects on lipoprotein levels, endothelium vasodilatation, insulin resistance, metabolic syndrome, antioxidant capacity, myocardial and cardiovascular mortality, and cancer incidence in obese patients and in those with previous myocardial infarction (141). Adherence to a Mediterranean diet pattern is potentially associated with defense against neurodegenerative disease and preservation of cognitive function, reduced inflammation and defense against asthma, amelioration of insulin sensitivity, and relatively high scores of objectively measured overall diet quality (138, 142, 166).

Studies have examined the active ingredients of a Mediterranean diet (149) and have placed a particular emphasis on high intake of vegetables, fruits, nuts, olive oil, and legumes; moderate intake of alcohol; and limited consumption of meat. The contributions of cereal grains and fish are less apparent, perhaps because of lesser effects on health outcomes or less variation available for assessment.

One recent study (43) demonstrated that the Mediterranean diet is better than a low-fat diet at improving a wide array of cardiac risk factors. Although lending support to the beneficial effects of a Mediterranean diet, the study was less effective in making the claimed comparison, as fat intake in the low-fat diet group was well above the stipulated threshold (88). A meta-analysis in 2011, however, also suggested potential benefits of Mediterranean diets over low-fat diets (124).

MIXED, BALANCED DIETS

"Mixed, balanced diet" is used here to indicate dietary patterns that include both plant and animal foods and conform to authoritative dietary guidelines, such as the Dietary Reference Intakes of the Institute of Medicine (**http://www.iom.edu/Activities/Nutrition/SummaryDRIs/DRI-Tables.aspx**), the Dietary Guidelines for Americans (**http://www.cnpp.usda.gov/dietaryguidelines.htm**), and the Dietary Recommendations of the World Health Organization (**http://www.who.int/nutrition/topics/nutrecomm/en/**).

Such diets have figured prominently in the intervention trials of the National Institutes of Health (NIH). The Dietary Approaches to Stop Hypertension (DASH) diet (122) and the dietary pattern used in the Diabetes Prevention Program (DPP) (97, 121) and subsequent related studies are salient examples. Perhaps because of the ultimate accountability of the NIH to the tax-paying population at large, these federal diets have focused both on enhancements of nutrition and real-world applicability. Even so, efforts to translate the findings of intervention trials to community application have realized limited success (3) and constitute an ongoing challenge.

The DASH diet, as it has evolved, is a mostly plant-based diet inclusive of some animal products, with an emphasis on low-fat and nonfat dairy products (17, 38, 107). The diet was originally tested for effects on blood pressure, from which the name derives, but was subsequently applied to both weight loss and general health promotion. Partly because of the extent of relevant literature, partly because of name recognition, and partly because of the imprimatur of the NIH attached to the diet and its consequent appearance in most federally sanctioned dietary recommendations, *U.S. News & World Report* has deemed DASH the most healthful diet in recent years (155). This designation, however, derives from the consensus opinion of a panel of expert judges rather than objective data. Data related to a direct comparison of DASH to other reasonable contenders for most healthful diet are lacking. Widespread support for the DASH diet may owe something to its pedigree, given that DASH trials enjoy the support of the National Heart, Lung, and Blood Institute. There are some concerns about potential adverse effects of dairy intake that DASH-related literature tends to ignore (102, 143). The Optimal Macronutrient Intake Trial for Heart Health (OmniHeart) has demonstrated short-term benefits for overall cardiovascular risk of several variations on the DASH diet theme—intake relatively high in carbohydrate, relatively high in protein, and relatively high in unsaturated fat—and suggested advantages to replacing some carbohydrate with either protein or fat (6, 23, 145). There are, however, no head-to-head comparisons of a DASH-style diet with other candidate dietary patterns to determine which produces the best long-term health effects.

The DPP (121), developed and conducted by the National Institute of Diabetes and Digestive and Kidney Diseases, incorporated a fairly similar diet, again emphasizing a mix of foods—especially plant foods and select, mostly lean animal foods—and restrictions of refined starch and added sugar. In combination with routine, moderate physical activity and associated weight loss, the DPP diet was associated with a 58% reduction in incident diabetes in adults with high risk (97). Subsequent study has indicated the persistence of such benefit, if only partially, over an extended time line (127, 132).

The DASH and DPP diets offer the likely merits of familiarity, accessibility, and avoidance of any particular dietary dogma. Despite such advantages, widespread adoption at the population level has not occurred. A direct comparison of these or related diets to other leading candidate diets with regard to health outcomes over time is lacking.

PALEOLITHIC DIETS

The particular focus in Paleolithic diets is on emulating the dietary pattern of our Stone Age ancestors with an emphasis on avoiding processed foods, and the intake of vegetables, fruits, nuts and seeds, eggs, and lean meats. In principle at least, dairy and grains are excluded entirely. Arguments for a Paleolithic diet derived initially, not from modern science, but from the universal relevance of adaptation. We may note, without debate or conflict, that the native diet of any species other than our own is clearly relevant to food selection. Zoological parks do not feed wild animals in captivity based on randomized trials; they feed them based substantially on the diets of their counterparts in the wild (87).

That *Homo sapiens* should be the one species for which native diet is irrelevant defies reason, and there is thus good reason to examine at least the basis for Paleolithic eating. There is a fairly strong case for the principle of a Paleolithic-style diet in the anthropology literature. The biomedical literature has limited evidence for this diet compared with the evidence for other dietary patterns reviewed here, but it is generally supportive.

Estimates of our Paleolithic dietary intake suggest that we are adapted to a high intake of plant foods and the nutrients they contain; a high intake of dietary fiber; and a fat intake of approximately 25% of total calories, which is below the typical level in the United States today and below the liberal fat intake of Mediterranean countries, but well above the intake associated with low-fat/vegetarian diets (42). One of the lesser challenges in reaching conclusions about the Paleolithic diet is variation in our ancestral dietary pattern and debate regarding its salient features (74, 99, 106, 131). In a modern context, an even greater challenge tends to be the wide variability in how the rubric is interpreted and applied and the impossibility of replicating our Stone Age dietary pattern with any real precision.

Many of the plant foods and nearly all of the animal foods consumed during the remote Stone Age are now extinct. Whereas the composition of some animals' flesh may mimic that of mammoths, the composition of the flesh of animals most often appearing in the food supply does not (78, 85). If Paleolithic eating is loosely interpreted to mean a diet based mostly on meat, no meaningful interpretation of health effects is possible. Even more meticulous interpretations of the Paleolithic diet tend to omit details, including but not limited to the very high-caloric throughput of Paleolithic humans, the dramatically different ratio of n-3 to n-6 fatty acids that now prevails, the dramatically different ratio of potassium to sodium that now prevails, the dramatically lower intake of fiber that now prevails, etc.

There is a scientific case for the Paleolithic diet, based in part on anthropological considerations. Intervention studies lend support as well (49, 74), suggesting benefits over the prevailing Western diet in measures of both body composition and metabolic health.

Among the more interesting controversies informing consideration and adoption of a Paleolithic diet is the relative importance of hunting and gathering to our Stone Age forebears. The term hunter-gatherer was modified to gatherer-hunter in some contexts over recent years, with a growing appreciation for the salience of plant foods in our native diet. There has been some subsequent unfavorable response, notably by Loren Cordain and colleagues (28, 29; **http://thepaleodiet.com/**), who have reaffirmed the importance of meat in the native *H. sapiens* diet, if not in the diets of our ancestors before *H. erectus*.

However even those emphasizing the role of hunting and meat suggest that some 50% of our Stone Age forebears' calories came from gathered plant foods. Given the energy density of meat relative to most plants, even this translates to a diet that is, by bulk, mostly plants. Although superficially a departure from the other contending diets, a reasonable approximation of a true Paleolithic diet would in fact be relatively low in fat; low in the objectionable carbohydrate sources—namely, starches and added sugars; high in vegetables, fruits, nuts and seeds, and fiber; and low glycemic. An emphasis on lean meat remains distinctive, however, and may represent an advantage related particularly to satiety (75).

VEGAN DIETS

A vegan diet excludes all animal products—notably, dairy, eggs, and meats. As with almost every other dietary approach, vegan eating can be done well or badly. Vegans, in general, tend to be especially mindful eaters and often adhere to the dietary pattern for reasons including, but not limited to, personal health. Ethical considerations related to the treatment of animals are often salient (**http://www.vegan.org/**). Those committed to long-term veganism are typically well versed in the need to combine plant foods to achieve complete protein and in the role of select nutrient supplements (30). Those who adopt veganism for a short term, particularly adolescents seeking rapid weight loss, are not as reliably well informed.

In general, vegan diets, when well constructed (33), are associated with health benefits (1, 40, 112). Intervention trials of short to moderate duration suggest benefits related to overall diet quality, inflammation, cardiac risk measures, cancer risk, anthropometry, and insulin sensitivity (10–12, 40, 150, 151).

Eating only plant foods does not guarantee a healthful, balanced diet. Sugar, among the more concerning dietary components consumed in excess, is of plant origin. Vegan diets, if ill conceived, can combine the adverse exposures of plant-based junk foods with nutrient deficiencies.

Veganism in free-living populations tends to be associated with particular health consciousness. Intervention trials of vegan diets are limited to those willing to be assigned to such a diet for a span of weeks, months, or years. Given such constraints, data from intervention trials that are related to direct comparison of vegan diets with various other dietary patterns, that are defended from bias, and that examine long-term health effects are essentially nonexistent. This does not argue against vegan diets, but it does argue against overstating the basis for them in evidence related to human health outcomes.

OTHER DIETARY PATTERNS

Claims for the specific advantages of diverse dietary practices abound. Many such practices, such as juicing or intermittent fasting, do not constitute a complete dietary pattern. Others, such as raw-food eating or calorie restriction, may be a complete dietary pattern but have limited population-level application, even if they do enjoy considerable attention in the media and popular culture. Space does not allow for full treatment of such practices here, but they are considered in the conclusions below.

DISCUSSION

Can we say what diet is best for health? If diet denotes a very specific set of rigid principles, then even this necessarily limited representation of a vast literature is more than sufficient to answer with a decisive no. If, however, by diet we mean a more general dietary pattern, a less rigid set of guiding principles, the answer reverts to an equally decisive yes.

The aggregation of evidence in support of (*a*) diets comprising preferentially minimally processed foods direct from nature and food made up of such ingredients, (*b*) diets comprising mostly plants, and (*c*) diets in which animal foods are themselves the products, directly or ultimately, of pure plant foods—the composition of animal flesh and milk is as much influenced by diet as we are (31)—is noteworthy for its breadth, depth, diversity of methods, and consistency of findings. The case that we should, indeed, eat true food, mostly plants, is all but incontrovertible. Perhaps fortuitously, this same dietary theme offers considerable advantages to other species, the environment around us, and even the ecology within us (136).

An important aspect of this message is that the same basic dietary pattern exerts favorable influences across a wide spectrum of health conditions. The notions that some combination of foods or nutrients is most important to the prevention and management of diabetes whereas another is most important to cardiovascular disease never made much sense and was very impractical: Given that people with diabetes are at heightened risk of cardiovascular disease, which should they choose?

The literature strongly supports a common set of dietary principles for health promotion and the prevention, or management, of virtually all prevalent conditions in modern societies. In this context, guidance that places an exaggerated emphasis on any one nutrient or food is ill advised (86, 89).

The message that there is a clearly established theme of healthful eating, relevant across generations, geography, and health concerns could, theoretically, exert a considerable and advantageous influence on public nutrition. This message, however, is at present a relatively feeble signal lost in a chorus of noise. In pursuit of marketing advantage, notoriety, or some other bias, the defenders of competing diets tend inevitably to emphasize their mutual exclusivities. This pattern conforms well with prevailing media practices (82, 92), and the result is perpetual confusion and doubt.

Both the scientific literature and consideration of indelible links between native diet and adaptation for all species including our own lead to the conclusion that a diet of foods mostly direct from nature and predominantly plants is supportive of health across the life span. That so much ostensible complexity distills down to so simple a message that is all but universally applicable is the particular point made by Michael Pollan in his *New York Times Magazine* essay on "nutritionism" (135). If as a society we were genuinely interested in consensus about the best dietary pattern, rather than a never-ending parade of beauty pageant contestants, the compatibilities and complementarities of all reasonable candidates for best diet would be fairly evident (**Figure 1**).

Even if the dietary destination were clearly and uniformly espoused, however, there would still be the challenges involved in getting there from here. The average supermarket in the United States offers in excess of 40,000 products, the majority of which are processed foods in bags, boxes, bottles, jars, and cans—virtually all of which sport marketing messages, many pertaining to health. Additional marketing messages populate pages, airwaves, and cyberspace (22, 26, 57, 120). For better or worse, there may be a need for nutritional analogs to GPS to traverse the foodscape and arrive at good health (21).

Ultimately, diets are made up of foods. Unlike a whole dietary pattern, which needs to be constructed over time, a food selection is a discrete choice that can be made at a given time. There is thus a potential practical advantage in dietary guidance directed at the level of either-or food selections. Real-world experience with such approaches suggests the possibility of benefit related to both health and weight (**http://www.nuval.com/**, **http://www.weightwatchers.com/index.aspx**). Among the better known of such tools is the Weight Watchers point system, originally pertaining only to calories but revised to incorporate salient considerations of nutritional quality (160). Another, developed by a team including the author, was specifically designed to stratify

	Low-carbohydrate	Low-fat/ vegetarian/vegan	Low-glycemic	Mediterranean	Mixed/balanced	Paleolithic
Health benefits relate to:	Emphasis on restriction of refined starches and added sugars in particular.	Emphasis on plant foods direct from nature; avoidance of harmful fats.	Restriction of starches, added sugars; high fiber intake.	Foods direct from nature; mostly plants; emphasis on healthful oils, notably monounsaturates.	Minimization of highly processed, energy-dense foods; emphasis on wholesome foods in moderate quantities.	Minimization of processed foods. Emphasis on natural plant foods and lean meats.
Compatible elements:	Limited refined starches, added sugars, processed foods; limited intake of certain fats; emphasis on whole plant foods, with or without lean meats, fish, poultry, seafood.					
And all potentially consistent with:	**Food, not too much, mostly plants[a,b,c].**					

[a]From Reference 135.
[b]Portion control may be facilitated by choosing better-quality foods which have the tendency to promote satiety with fewer calories.
[c]While neither the low-carbohydrate nor Paleolithic diet need be "mostly plants," both can be.

Figure 1

The theme of optimal eating. Diverse diets making competing claims actually emphasize key elements that are generally compatible, complementary, or even duplicative. Competition for public attention and a share of weight-loss/health-promotion markets results in exaggerated claims and an emphasis on mutually exclusive rather than shared elements.

foods on the basis of overall nutritional quality for purposes of health promotion (27, 93, 94) and has proven in some cases to be a potent contributor to weight loss (125). Other such systems exist in the United States and around the world (164). The potential utility of validated tools to guide food choice, combined with consistent messages about the theme of healthful eating, could represent a powerful combination in the service of public nutrition.

The clutter of competing claims likely obscures the established body of knowledge and forestalls progress, much like the proverbial trees and forest (76, 91). We need less debate about what diet is good for health, and much more attention directed at how best to move our cultures/societies in the direction of the well-established theme of optimal eating, for we remain mired a long way from it. This problem is particularly acute in the United States, where life expectancy lags behind that of other developed countries, and health expectancy that much more so (67). Public health objectives related to nutrition could almost certainly be facilitated by widespread endorsement of the basic theme of what we truly do know to be healthful eating, a candid acknowledgment of the many details we simply do not know, and a concerted effort to do all that is needed to help people get there from here.

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