Diet and Diabetes: Lines and Dots

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Abstract

Diabetes, particularly type 2 diabetes, is epidemic in the United States among adults and children alike, and increasingly prevalent around the world. On its current trajectory, the increasing incidence of diabetes has the potential to ravage both public health and economies. There has, however, been evidence for decades that lifestyle has enormous potential to prevent chronic disease, diabetes included. Studies suggest that the combination of tobacco avoidance, routine physical activity, optimal dietary pattern, and weight control could eliminate as much as 80% of all chronic disease, and 90% of cases of diabetes specifically. None of these factors is necessarily easily achieved, but most are simple. Diet, on the other hand, is complex, and arguments abound for competing diets and related health benefits. From an expansive review of relevant literature, the case emerges that the overall theme of optimal eating for human beings is very well established, whereas the case for any given variation on that theme is substantially less so. Once the theme of healthful eating is acknowledged, the challenge shifts to getting there from here. Although much effort focuses on the wholesale conversion of dietary patterns, the introduction or removal of highly nutritious foods can have direct health effects, and potentially reverberate through the diet as well, shifting the quality of the diet and related health effects. Studies demonstrating favorable effects of daily walnut ingestion in diabetes and insulin resistance are profiled as an illustration, and an ongoing study examining the implications of daily walnut ingestion on diet quality and various biometric variables is described. The line between dietary pattern and the epidemiology of diabetes is indelibly established; we must work to connect the dots between here and there. J. Nutr. 144: 567S–570S, 2014.

The Diabetes Debacle

Diabetes is epidemic in the United States, and increasingly the world (1). Within the span of the past 2 generations, type 2 diabetes has transformed from a disease largely limited to vulnerable adults at midlife (i.e., adult-onset diabetes), and to an occasional diagnosis in children, to a widespread pediatric scourge. There are ~27 million diagnosed diabetics in the United States at present, most of whom have type 2 diabetes (2). Projections by the CDC indicate that, should current trends persist, by approximately the middle of this century 1 in 3 Americans will be diabetic (3). There are countries in which the current prevalence is even higher, and the looming trends even more dire (4).

Data in the United States indicate that the ominous predictions of the CDC, potentially ruinous to public health and the national economy alike, are already well underway. Also established is that along with the briskly increasing incidence of type 2 diabetes in childhood, the disease is proving more treatment-resistant and virulent in children than in adults (5). As in adults, diabetes in children is associated with increased risk of vascular disease. Ever more cardiac risk factors are present at ever younger ages, and an increased incidence of stroke among 5- to 14-y-olds in the United States has been reported (6), with nothing but epidemic childhood obesity to account for it.
Nothing but Sugar
Against the backdrop of this ominous epidemiology, the claim has emerged that dietary sugar is the primary culprit. As with all oversimplified messages that hint at both conspiracy theory causes and silver bullet remedies, this one has captured the public imagination. Although this message has been reverberating for some time now, it gained additional momentum with the publication in February 2013 of an ecological study linking increasing availability of dietary sugar to an increasing prevalence of diabetes (7). This, in turn, invited assertions in the popular press that sugar is not merely a contributor to pandemic diabetes but the cause, even to the exclusion of obesity (8). Such exaggerations were retracted, but they suggest the popular appeal of indicting just 1 nutrient for our dietary ills.

Sweet Nothings, Bitter Truth
The reality, of course, is that excess dietary sugar is one among many liabilities of the modern food supply, and of the prevailing American diet. The overall dietary pattern in the United States, and increasingly the world, is at diverse odds with recommendations for optimal health. Epidemic obesity in adults and children alike is fueled by many excesses, most notably total energy intake, and various deficiencies, including, in particular, daily physical activity. As a result, poor diet and sedentariness have long figured in the short list of modifiable factors responsible for the annual toll in premature mortality. These 2 factors plus just 1 more, tobacco use, account for ~80% of premature deaths each year (9,10).

What Diet Can Do
Those, then, are the dark clouds hovering over modern public health. Fortunately, they are home to a lining as luminous as they are somber. Just as we have had evidence for decades that bad use of feet (inactivity), forks (poor dietary choices), and fingers (tobacco use) are major causes of chronic disease and premature death, so have we had evidence that better use of these same levers could move modern public health to a fundamentally better place. A repetitive drumbeat of peer-reviewed publications has indicated that through the application of lifestyle as medicine, fully 80% of all chronic disease can be eliminated (11–13). Just by eating more in accord with best practices, we might eliminate ≥50% of all chronic disease. Lifestyle interventions have been shown to prevent diabetes specifically in at-risk adults and children (14,15) and to modify gene expression in a manner likely to reduce the risk of chronic disease development, recurrence, or progression (16).

What Diet, Can Do?
This, in turn, raises a question: can we say with any degree of confidence what “best practices” are for dietary intake? Although the answer might be “no” at the level of devilish details, it is a decisive “yes” more generally (17).

Evidence supports diets that are preferentially composed of minimally processed foods direct from nature, and food made up of such ingredients. Furthermore, it supports diets composed mostly of plants, and diets in which animal foods are themselves the products, directly or ultimately, of pure plant foods—because the composition of animal flesh and milk is as much influenced by diet as is our own (18). The sum of evidence in support of these basic principles 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.

An important aspect of this message is that the same basic dietary pattern exerts favorable influences across a wide spectrum of health conditions. The notion that some suite 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 impractical. Because diabetics 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 1 nutrient or food is ill-advised (19,20).

The message that there is a clearly established theme of healthful eating, relevant across generations, geography, and health concerns, theoretically could exert a considerable and advantageous influence on public health nutrition. This message, however, is generally at a disadvantage as proponents of competing diets emphasize their mutual exclusivities. This pattern propagates perpetual confusion and doubt.

Both the scientific literature and consideration of the 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. This message, however, is generally at a disadvantage as proponents of competing diets emphasize their mutual exclusivities. This pattern propagates perpetual confusion and doubt.

But even if the dietary destination were clearly and uniformly espoused, 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. Ultimately, diets are made up of foods. Unlike a whole dietary pattern, which needs to be constructed over time, a food 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. Similarly, there is potential to improve the pattern of the diet one food choice at a time (22,23).

Going, Selectively, Nuts
Foods useful in favorably influencing the pattern of dietary intake and attendant health indices are, in general, whole foods, direct from nature, and rich in nutrients. Foods low in calories might be desirable, but an alternative is to leverage the satiety value of energy-dense foods such as nuts (24,25). A large and growing body of literature associates nut intake with favorable health effects, including favorable effects on appetite and energy balance. Specific benefit has been associated with walnut intake, and when compared objectively with the overall nutritional quality of other nuts, that of walnuts is exceptionally high.
of diabetes. Two studies have been completed and published, and a third study is ongoing.

Study 1, published in *Diabetes Care* in 2010 (26), was a randomized, controlled, single-blind crossover trial assessing the effects of daily walnut ingestion in adults with type 2 diabetes. Twenty-four participants (mean age: 58 y; 14 women and 10 men) were randomly assigned to 1 of the 2 possible sequences of an ad libitum diet enriched with 56 g (366 kcal) walnuts/d and an ad libitum diet without walnuts for 8 wk.

Participants underwent endothelial function testing (measured as flow-mediated dilation (FMD)) of the brachial artery (27) and assessment of cardiovascular biomarkers before and after each 8-wk treatment phase. The primary outcome measure was the change in FMD at 8 wk; secondary measures included plasma lipids, glycosylated hemoglobin, fasting glucose, insulin sensitivity, and anthropometric measures. Endothelial function, measured as percentage change in brachial artery diameter, significantly improved after consumption of a walnut-enriched ad libitum diet compared with the control condition (2.2 ± 1.7% vs. 1.2 ± 1.6%; *P* = 0.04). There were no significant changes in anthropometric measures, plasma glycosylated hemoglobin, and insulin sensitivity. Fasting serum glucose increased whereas serum total cholesterol and LDL cholesterol decreased from baseline concentrations [10.0 ± 20.5 mg/dL (P = 0.04), −9.7 ± 14.5 mg/dL (P < 0.01), and −7.7 ± 10 mg/dL (P < 0.01), respectively] with the walnut assignment, but these measures did not differ significantly from the control condition. By affirming the a priori study hypothesis, this trial suggested a potential reduction in overall cardiac risk among people with diabetes with routine intake of walnuts.

Study 2, published in the *Journal of the American College of Nutrition* in 2012 (28), assessed the effects of daily walnut intake on similar measures in adults with central obesity but without diabetes. For this randomized, controlled crossover trial, 46 overweight adults (mean age: 57.4 y; 28 women, 18 men) with elevated waist circumference and ≥1 additional signs of metabolic syndrome were randomly assigned to 2 8-wk sequences of a walnut-enriched ad libitum diet and an ad libitum diet without walnuts, separated by a 4-wk washout period. The primary outcome measure was again the change in FMD of the brachial artery. Secondary measures included serum lipids, fasting glucose, and insulin, HOMA-IR values, blood pressure, and anthropometric measures.

FMD again improved significantly from baseline with walnut ingestion (1.4 ± 2.4% vs. 0.3 ± 1.5%; *P* = 0.019). Beneficial trends in systolic blood pressure were seen, and maintenance of the baseline anthropometric values was also observed with the walnut assignment. Other measures were unaltered. This study suggested that ingestion of walnuts improves endothelial function in overweight adults with visceral adiposity without producing weight gain despite the caloric content of our treatment and the energy density of walnuts.

On the basis of these findings, a third study, now ongoing, was initiated. The current protocol is designed to test the longer-term effects of daily walnut ingestion on diet quality, weight, body composition, and cardiac risk measures in overweight adults with elevated waist circumference (i.e., at increased risk of diabetes). The recruitment target of 112 participants was reached, and the study is nearing completion at the time of writing (July 2013).

**Connecting Dots**

The potential for diet to improve public health and the human condition is enormous. Despite knowing the potential power of lifestyle as medicine for decades, relevant progress has been minimal—and, in many cases, circumstances have regressed rather than advanced. This disconcerting reality should by no means forestall ongoing efforts to improve the typical American diet wholesale. But such stagnation, at a minimum, invites consideration of new approaches in tandem.

There may be many such innovations, but one among them is to encourage the intake of highly nutritious, satiating foods with the potential to improve diet and health by virtue of what they add to the diet, and perhaps in part because of what they displace as well (29). Our studies to date attribute just such salutary effects to habitual walnut ingestion, and complement other work indicating the health-promoting benefits of nut ingestion in general, and walnut ingestion in particular. Even as efforts to improve diets continue, we may expedite progress by measuring our advances 1 well-informed food choice at a time.

**Literature Cited**


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