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Economic Costs and Benefits of Healthy Eating

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Abstract Most Americans fail to meet federal dietary recommendations. This may be partly due to the costs of healthy eating. This article reviews the costs and benefits of healthy eating. On the cost side, we discuss food prices, food preparation and other time costs, transportation costs, psychological costs, costs of obtaining nutrition information, and costs of longer life expectancy. We do not summarize these costs with a single dollar value as the current literature does not provide estimates to support such quantification. In terms of benefits, we focus on five health conditions for which poor diet is a major risk factor: coronary heart disease, cancer, stroke, diabetes, and osteoporotic hip fractures. We estimate the benefits of healthy eating in the United States to be $114.5 billion per year (in 2012 dollars) in medical savings, increased productivity, and the value of prolonged life that are associated with reductions in these five conditions.

Keywords Healthy diet · Costs · Benefits · Nutrition · Food prices · Obesity · Healthy eating

Introduction

Despite continued federal dietary guidance, Americans' diets are far from optimal [1••]. Understanding the costs and benefits of healthy eating is important for understanding how and why people choose their diets and how diet quality can be improved. While much of the public health and economics literature has concentrated on an isolated cost or benefit of healthy eating, this paper unifies all of the costs and benefits that are relevant to decisions about healthy eating. We bring together recent literature from economics, medicine, public health, nutrition, and psychology to give a complete picture of the incentives and disincentives related to healthy eating patterns. In so doing, we consider both monetary and non-monetary factors. We define costs as the various costs that would be borne by individuals and society if people were to consume healthy diets; we define benefits as the value of the population health improvements that would occur if the US population consumed healthy diets. We focus on diet, so we abstain from in-depth discussion of obesity, which has multiple causes besides diet. This review is restricted to the English-language literature and most of the references cited are from 2008 or later.

In the remainder of this article, we first define healthy eating, then review the evidence on the costs and benefits of healthy eating, then conclude by discussing what these costs and benefits mean for future progress toward improving diet in the US population. Figure 1 presents a tree structure of the costs and benefits that are considered in this article.

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What Is Healthy Eating?

This article defines healthy eating in accordance with the *Dietary Guidelines for Americans*. Every 5 years, the US government reviews and publishes the *Dietary Guidelines*, which are recommendations for a healthy diet for the US population. Designed for Americans aged 2 years and older, these guidelines focus on foods and beverages that help people "attain and maintain a healthy weight, promote health, and prevent disease" [2••]. As described by the *Dietary Guidelines*, healthy diets limit intake of sodium, saturated and trans fats, added sugars, and refined grains and emphasize consumption of nutrient-dense foods and beverages, especially vegetables, fruit, whole grains, fat-free or

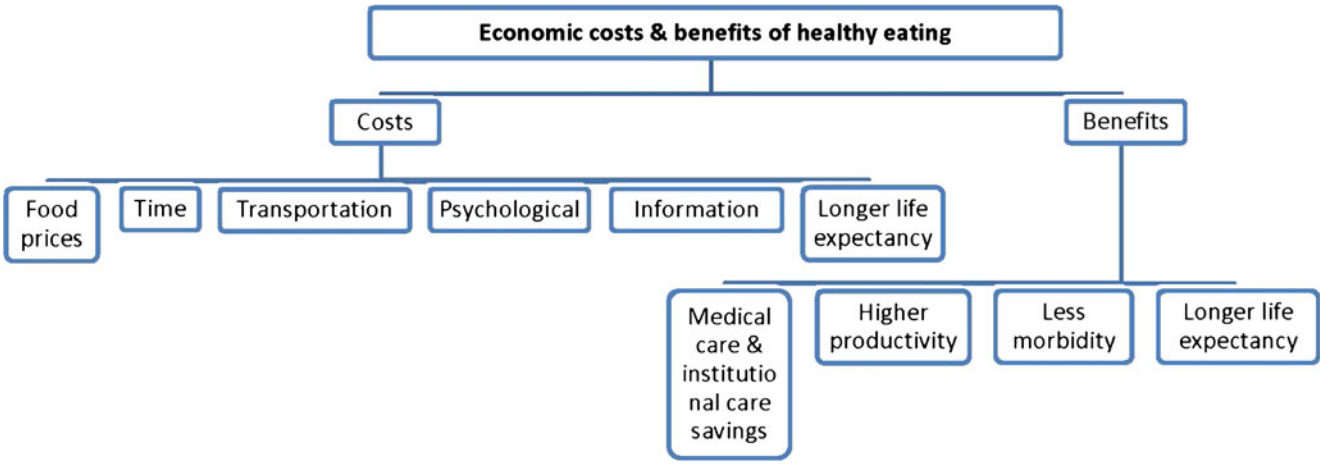

Fig. 1 Tree structure of the economic costs and benefits of healthy eating

low-fat milk and other dairy products, seafood, lean meats and poultry, eggs, beans and peas, and nuts and seeds. The *Dietary Guidelines* also draw attention to the dietary needs of specific population groups—for example, iron, folate, and seafood low in methyl mercury for fertile women; and sources of vitamin B_{12} for older adults [2••].

Economic Costs of Healthy Eating

Food Prices

Declining Food Prices

The real price of unhealthy foods has been declining for decades. An analysis of Consumer Price Index (CPI) data found that the real price of vending-machine food had dropped during 1978–2007 by about 11 % and soda had dropped by about 38 %, but the real price of fruit and vegetables had *increased* by about 18 % [3]. Kuchler and Stewart [4] found that this price increase for fruit and vegetables has been driven by new produce items that incorporate labor-saving innovations (i.e., "prepared" produce such as washed and bagged spinach, broccoli florets, and baby-cut carrots). Their study analyzed price trends for unprepared produce that remained unchanged between 1980 and 2006 and showed that price trends for unprepared produce were similar to those for the less-healthy categories of snacks and desserts. This implies that consumers who wish to economize financially by purchasing unprepared (rather than prepared) produce face an additional time burden, as they bear the time cost of labor such as washing, peeling, cutting, and chopping the produce.

In addition, Lakdawalla and Philipson found that the price of food fell relative to the price of non-food items from 1976 to 1994. This relative decrease in the price of food may have promoted overeating—one component of unhealthy eating—because the price of food rose less than inflation and was thus comparatively more affordable than other goods [5]. However, this trend of declining relative prices for food compared to non-food recently reversed as food prices surged in 2007 and 2008 [6].

Total Cost of a Healthy Diet

The Center for Nutrition Policy and Promotion's Thrifty Food Plan (TFP) is a national standard for a healthy diet at minimal cost and is used as the basis for maximum Supplemental Nutrition Assistance Program (SNAP; formerly the Food Stamp Program) allotments [7]. The TFP assumes that all food is prepared at home and minimizes deviations from currrent dietary patterns. The TFP finds that it is possible to eat healthy for low cost: the TFP budget in 2008 for a family of four was $136 per week, of which $54 (40 %) was earmarked for fruit and vegetables. However, adherence to the TFP imposes significant time costs (e.g., the need for bargain-hunting, traveling to and from the store, shopping, food preparation, cleanup). Because of these and other limitations, the TFP has been criticized as unrealistic [8, 9•].

Mediterranean dietary patterns are considered healthy, partly because they are associated with lower incidence of cardiovascular disease and lower rates of total mortality [2••]. The diet can be expensive [10], but Goulet et al. [11] found that middle- and upper-class consumers can achieve it (at no extra cost) by focusing on the lower-cost foods from the diet (e.g., pulses, legumes, nuts, dried fruit, canned fish) and buying less red meat, sweets, and fast foods in favor of healthy foods. However, Goulet et al. note that their study of the affordability of Mediterranean dietary patterns underrepresented people of low socioeconomic status, so no conclusions could be drawn about this population who may very well find such diets unaffordable.

Energy Density

Energy-dense foods have a high ratio of calories per gram. Some researchers [12–15] argue that low-income consumers eat energy-dense foods (e.g., sweets, fast food, many snacks) because these foods are a cheaper source of calories than low-energy-density foods (e.g., fish, vegetables, fruit).

This claim has been contentious for a few reasons. First, the negative association between energy density (calories/gram) and cost per calorie ($/calorie) may be spurious because of mathematical coupling, in which two variables that share a common component are compared [16]. Second, consumers with energy-dense diets in many cases spend the same amount of money on food as those with less-energy-dense diets [17]—so healthy eating is financially within reach for many consumers with energy-dense diets [17, 19••]. Third, if consumers chose foods based on cost per calorie, then the current trend of marketing foods with phrases such as "low-calorie" would not exist because such marketing claims would imply a poor bargain in terms of cost per calorie [18].

Weighing in on this debate is a recent study by Carlson and Frazão [19••] comparing various measures of food cost. The authors systematically compared the cost of healthy and unhealthy foods using three different cost metrics: price per 100 calories, price per 100 edible grams, and price per average portion. They found that healthy foods are actually *less* expensive than unhealthy foods when cost is measured as price per 100 edible grams or price per average portion. (Healthy foods were defined as those containing at least half a portion size of a *Dietary Guidelines* major food group and containing low to moderate amounts of saturated fats, added sugars, and sodium.) These findings underscore how important the choice of cost metric is when discussing the cost of healthy versus unhealthy foods.

Diet Quality, Income, and Spending

If healthy diets cost more, then consumers who spend more may eat healthier. The weight of the literature suggests that consumers who spend more on food tend to have healthier diets as meaured by the Healthy Eating Index [22, 23]. On the other hand, individuals who switch to a healthier diet—such as pregnant women following a low-glycemic diet [24] or obese children undergoing dietary treatment [25]—can do so without increasing their daily dietary costs.

If healthy diets are more expensive, then poorer people should have worse diets. Two systematic reviews [26, 27••] support this conclusion, finding that consumption of fruit and vegetables was positively associated with income. In England, the poor had worse diets and ate less fruit [28]. Poor consumers in the Phoenix, Arizona, area had worse diets, with the exception of lower quantities of saturated fat [29]. On the other hand, a study using 2001–2002 National Health and Nutrition Examination Survey data showed that income had little influence on diet quality [30].

We conclude that there is a weak positive relationship between food spending and healthy diet. Although the TFP shows that it is possible to eat healthy at low (monetary) cost, adhering to the TFP guidelines imposes a high utility cost on individuals (such as time), so few people actually follow it. Economic theory suggests that people maximize utility subject to their budget constraint; as their budget constraint relaxes, people can purchase food that provides more utility in terms of health, leisure time, and palatability.

Time Costs

Time costs are driven by the opportunity cost of time. People may therefore eat healthier during brief recessions because joblessness increases leisure time, making it cheaper to undertake health-producing activities such as preparing healthy meals [31]. (However, during a long-lasting economic downturn, reductions in employment and income likely do not lead to healthier diets.)

Food prepared at home (FAH) is generally healthier than food away from home [32, 33] but it requires the time cost of activities such as grocery shopping, food preparation, and cleanup. These costs can be substantial. Economists have estimated the time costs of FAH by multiplying the opportunity cost of people's time (e.g., wage rate) by the number of hours spent in FAH activities. The daily household time cost of food preparation and cleanup was $20.43 (50 min) per SNAP household and $21.62 (45 min) per non-SNAP household for people who performed housework and market work in 2003–2006 [34••]. Women have a higher time cost than men [35••].

Compared to the general population, SNAP participants have higher time costs and lower food input costs for FAH. But if SNAP participants were to follow the TFP, their daily time costs would have to increase further, from the current $8.66 (38 min) to $15.84 (72 min), while their monetary costs would marginally increase from $8.40 to $8.56 [35••]. That is, when total TFP time costs are monetized, they are 85 % higher than the cost of the food itself. In other words, the TFP is expensive once its associated time requirements are factored in [8, 35••]. Households' actual SNAP participation status was not known in this study [35••], so the authors inferred SNAP participation from household demographics.)

Time is also required to develop cooking skills in the first place. Cooking skills may have deteriorated over the last several decades, leaving many people without the skill to time-efficiently prepare healthy meals [36]. (Declining confidence in one's skills may also be an issuel [37].) A study of young adults 18–23 years old found that 18 % of women and 23 % of men cited their inadequate cooking skills as a barrier

to food preparation; the study also found an association between cooking and healthy diet [38]. Cooking skill is positively associated with consumption of fruit and vegetables and negatively associated with consumption of convenience foods [39].

Transportation Costs

Consumers also incur transportation costs (e.g., gasoline) while traveling to grocery stores. People who live in food deserts—areas with limited access to affordable, healthy food—often incur higher transportation (and time) costs because supermarkets are far from their homes [40, 41]. Low-income Americans are especially likely to live in food deserts, but evidence regarding socioeconomic disparities for other countries is scant [42].

Apart from grocery stores, access to healthy restaurants is also an issue. Restaurants in poorer Los Angeles County neighborhoods with a higher proportion of black residents have fewer healthy food options [43]. Higher concentrations of fast-food restaurants exist in poor and minority communities, although further work is needed to understand if and how access to fast food impacts dietary intakes and health outcomes [44].

Psychological Costs

This section reviews the psychological costs of healthy eating—that is, the psychological stress caused by healthy eating or the pursuit of healthy eating.

Habit, convenience, preferences, and taste are important determinants of a diet. Taste is enhanced by fat, sugar, and sodium, which are prevalent in many unhealthy products [45, 46]. Food marketing caters to consumers' preferences for these substances—and stimulates their demand for these products—by developing foods designed to hook consumers and by advertising especially to children [47, 48].

Perception also affects dietary behavior. When consumers see information touting the healthiness of a food, they often assume that the food has an inferior taste, and this assumption decreases their enjoyment of the product [49, 50]. When consumers are told that a food is healthy, they perceive it to be low in calories, which leads to overeating [51]. Large portions increase the psychological costs of healthy diet as consumers are tempted to finish their portions, leading them to overeat [52]. Furthermore, food vendors tend to supersize portions as the marginal cost of adding food to the portion is low [52]. Competition between food manufacturers can reduce incentives to introduce smaller portions and packages, especially many consumers have self-control problems with limiting their consumption [53].

Healthy behavior in one dietary area can be compensated for by unhealthy indulgence in another [51]. For example, consumers who take vitamins tend to eat less healthy, as they feel protected from negative health consequences [54]. Thus, healthy dietary behaviors may increase psychological costs by requiring greater self-discipline in other dietary areas.

One important feature of a healthy diet is that its benefits often occur in the distant future, while its costs (e.g., perceived inferior taste) occur immediately. Uncertainty about the future [55], impatience, and future discounting [56] all increase the psychological costs of healthy eating. One way to alleviate such problems is to introduce a lag between the day one selects and pays for groceries and the day one actually receives the food, as this delay leads to healthier purchases [57•].

Physiology and sociocultural norms also affect the cost of healthy eating. For individuals with strong self-control, consumption of unhealthy food leads to earlier satiation of the desire for such foods, reducing the psychological costs of eating healthy [58]. Genetic variations, as in the *TAS2R38* gene, affect preferences for sugar, fat, fruit, and vegetables [59, 60]. Choosing unhealthy food is easier when one is alone and anticipates dealing only with one's own guilt rather than with the shame of being witnessed [61]. Exposing children to healthy eating early in life creates good dietary habits, which reduces the psychological costs of healthy diet in the future [62].

Impulse shopping is associated with the purchase of unhealthy foods, so curbing impulsive purchases of unhealthy foods is a psychological cost of healthy eating. Consumers are more likely to purchase unhealthy foods when they pay by credit card rather than cash because paying in cash feels more painful and this pain can curb impulsive purchase decisions [63].

Information Costs

The information costs of healthy eating are the time and effort required to obtain nutrition information and update one's nutrition knowledge. Getting people to eat healthy may also require funding for education and informational campaigns designed to reorient people to a culture centered around healthy diets.

Researchers have identified three types of nutrition knowledge that promote healthy eating: 1) awareness that there is a link between diet and health (e.g., a link between saturated fat and heart disease), 2) knowledge of nutrition principles (e.g., recommendations on the percentage of calories that should come from fat), and 3) and knowledge of foods' specific nutrient content (e.g., which foods have more fiber, fat, or cholesterol) [64, 65].

Providing consumers with nutrition information at the point of purchase reduces their information costs. By

requiring that nutrition labels have a standardized format and be easy to read, the 1990 Nutrition Labeling and Education Act (NLEA) helped consumers use nutrition information if they were already motivated to search for and process such information [66] and improved the diets of consumers who used nutrition labels [67, 68]. Providing nutrition information to consumers can cost firms as well, as in the case of firms being required to comply with the 2010 Patient Protection and Affordable Care Act, which mandates nutrition labeling of menu items.

After finding nutrition information, consumers must then analyze it. Consumers spend an average of 12.3 s acquiring nutrition information for each grocery item they select [70]. To calculate total time spent per shopper, this number would have to be multiplied by the number of grocery items that a shopper selects, and then added to the time cost for all other items that a consumer examines but does not ultimately select. This information cost may diminish somewhat over time as consumers learn the nutritional content of their favorite items but consumers may also have to continually spend time examining new products entering the market.

As nutrition science advances, consumers also face the cost of periodically updating their basic nutrition knowledge. Trans fat is a recent example. Consumers who were uninformed about the link between trans fat and poor health were unable to take advantage of the trans fat information that was added to the Nutrition Facts panel in 2006 [71, 72].

Costs of Longer Life Expectancy

Healthy diets extend life expectancy, which can result in extra costs due to age-related health conditions. The prevalence of chronic conditions (e.g., cardiovascular disease, diabetes, cancer, dementia, physical disability) increases with age [73].

Economic Benefits of Healthy Eating

The economic benefits of healthy eating are the value of the population health improvements that would be realized by shifting a population to an optimal diet, all else being equal. Shifting the US population to an optimal diet would reduce the prevalence of not only several risk factors—e.g., obesity, hypertension, high blood cholesterol, insulin resistance—but also myriad chronic diseases, including coronary heart disease (CHD), stroke, type 2 diabetes, osteoporosis, and cancers of the stomach, colon, rectum, esophagus, oral cavity, larynx, and pharynx [74, 75].

Healthy diets reduce morbidity and mortality and produce many kinds of economic benefits: lower medical care and institutional care costs, higher productivity, improved quality of life, and increased life expectancy. Our literature search did not reveal any work published in the last 10 years that estimates the costs of current eating patterns in the United States; however, a 1999 study by Frazão [76] estimates that healthier diets in the United States would annually prevent $70.9 billion (in 1995 dollars) in medical costs, lost productivity, and the value of premature deaths associated with four health conditions: CHD, cancer, stroke, and diabetes. Three of these conditions—CHD, cancer, and stroke—were and still are among the top four causes of death in the United States, while diabetes was and still is the seventh leading cause of death (Table 1) [77–79]. Of the top ten causes of death, these four are the conditions for which diet (excluding alcohol) is a major risk factor [75, 80]. In addition, the annual diet-related cost of a fifth condition—osteoporotic hip fractures—has been estimated to be at least $5.1 billion in 1995 dollars, accounting for medical care, extended-treatment facilities, and lost productivity (including productivity lost due to premature death) [81]. The sum of these diet-related costs of CHD, cancer, stroke, diabetes, and osteoporotic hip fractures is $76 billion in 2005 dollars, or $114.5 billion in 2012 dollars after updating with the "all items" CPI. (These costs include not only medical care but also other items such as lost productivity and the value of premature death, so we were conservative in applying the smaller "all items" CPI rather than the larger "medical care" CPI.)

This figure is likely an underestimate for a number of reasons. First, it does not include many diet-related conditions caused by overweight, osteoporosis, and hypertension, nor does it include neural tube defects. For example, overweight causes osteoarthritis, gallbladder disease, sleep apnea, and respiratory problems [82, 83]. The medical and indirect costs of obesity are estimated at $139 billion annually in 2003 dollars [84]; however, only the diet-related portion of these obesity costs are pertinent to this paper and some of these diet-related obesity costs have already been included because obesity contributes to the chronic diseases considered earlier. Also, our estimate does not include the diet-attributable costs of osteoporotic *non*-hip fractures, such as in the spine and wrist, among others [85]. Nor does our estimate account for the diet-attributable value of premature deaths due to osteoporotic fractures [86, 87] or for the fact that hypertension is a major contributor to end-stage renal disease [88]. Although folic acid supplements are taken by many reproductive-age women and the food supply is fortified with folic acid, some reproductive-age women still have low total folate intakes [89], which increases risk for neural tube defects among infants. Finally, healthy diets are associated with a lower likelihood of depression, although it is unclear in which direction the causality runs or if the causality is bidirectional [90].

In addition, the value of premature death is now typically measured by a much higher figure known as the value of a

Table 1 Leading causes of death, United States, 1994 and 2010

1994			2010		
Cause of death	Number of deaths	Percentage of all deaths	Cause of death	Number of deaths	Percentage of all deaths
1. Heart disease	732,409	32.1	1. Heart disease	597,689	24.2
Coronary heart disease	**481,458**	**21.1**	**Coronary heart disease**	**379,559**	**15.4**
2. Cancer	**534,310**	**23.4**	**2. Cancer**	**574,743**	**23.3**
3. Stroke	**153,306**	**6.7**	3. Chronic lower respiratory diseases	138,080	5.6
4. Chronic obstructive pulmonary diseases and allied conditions	101,628	**4.5**	**4. Stroke**	**129,476**	**5.2**
5. Accidents and adverse effects	91,437	**4.0**	5. Accidents	120,859	4.9
6. Pneumonia and influenza	81,473	3.6	6. Alzheimer's disease	83,494	3.4
7. Diabetes	**56,692**	**2.5**	**7. Diabetes**	**69,071**	**2.8**
8. Human immunodeficiency virus infection	42,114	1.8	8. Nephritis, nephrotic syndrome, and nephrosis	50,476	2.0
9. Suicide	31,142	1.4	9. Pneumonia and influenza	50,097	2.0
10. Chronic liver disease/cirrhosis	25,406	1.1	10. Suicide	38,364	1.6
All causes	2,278,994	100.0	All causes	2,468,435	100.0

Boldfaced are those health conditions for which diet (excluding alcohol) is a major risk factor

Sources: [76–79]

statistical life (VSL). Frazão applied a value of over $412,000 for deaths at age 60 years and over $143,600 for deaths at age 70 years whereas the majority of VSL estimates at the time [91] spanned a range starting around $3 million per death in 1995 dollars. The VSL is designed to measure society's collective willingness to pay to prevent premature death for one unspecified person; it captures non-earnings income, the value of leisure, aversion to risk, and the value of avoiding pain and suffering [92]. Frazão notes that using the VSL to value diet-related premature deaths changes her $70.9-billion cost of poor diet to some $474 billion each year, or $714 billion in 2012 dollars.

Furthermore, the prevalence of overweight, hypertension, and diabetes have continued to rise since the time of Frazão's work [93, 94]. Also, population growth and aging have increased the number of cases of diet-related chronic diseases [95, 96]. Treatment and prevention strategies have changed. Although new treatments for cardiovascular disease and cancer have improved detection of cancer and extended patients' life [97–99], the treatments, at least in the case of cancer care, have been more costly [100], and longer lifespans due to treatment may mean longer time lived with disability, which also increases costs. These factors have all increased the diet-related costs of unhealthy eating, or the diet-related benefits of *healthy* eating. Finally, medical care costs have risen faster than costs for "all items" so applying the "medical care" CPI to the medical care costs in Frazão's paper would have further increased our updated estimate.

In sum, the estimated annual economic benefits of healthy eating are $114.5 billion in 2012 dollars. This estimate likely understates the true economic benefit of healthy eating in the United States. Although this estimate reflects the current published literature, data gaps remain. For example, since Frazão's work, medical costs and practices for various health conditions have changed, the population structure has aged, and obesity prevalence has increased. Future work on this topic should account for these factors and for a larger set of diet-related health conditions (including, for example, overweight, osteoporosis, hypertension, neural tube defects).

Conclusions

Economists assume that consumers are rational individuals who carefully compare all the costs and benefits of a decision before acting. In this article, we have described the costs and benefits of healthy eating from an individual and societal perspective. The price of healthy foods, while not a great barrier by itself, conspires with other barriers such as time constraints and consumer preferences for unhealthy foods, resulting in a high prevalence of unhealthy diets. This is especially a problem for money- and time-constrained consumers.

Food prices fell relative to non-food prices over the last several decades and this trend may continue in the future, so the monetary cost of healthy eating may be losing its relative importance. However, consumers have only 24 h a day. Healthy diets often require shopping, travel, preparation, and cleanup that can be a burden on time-poor consumers.

Meanwhile, unhealthy fast foods and convenience foods are often nearby and readily available.

Convenience, consumer psychology and physiology, and the food environment affect the psychological costs of healthy eating. Many consumers are drawn to unhealthy foods, and this problem can be exacerbated by genetic predisposition and poor dietary habits acquired in childhood. The food environment—such as large portions, fast-food advertising, and food deserts—can increase the costs of healthy diet. Because the benefits of healthy eating occur in the distant future and enjoyment of unhealthy food starts immediately, consumers with strong self-control experience a lower cost of healthy diet.

None of these costs may matter if consumers do not know what a healthy diet is. Thus the cost of acquiring nutrition information is one of the first costs consumers incur on the path to a healthy diet.

Although we estimate the monetary value of the benefits of healthy eating, we do not do the same for the costs. Given the scope of this review, it was not feasible to monetize the costs as the current literature does not provide estimates to support such quantification.

If we compare the costs and benefits, we see that many of the costs (monetary, time, psychological) are borne by private individuals but the benefits are shared more evenly between private individuals and society as a whole. That is, the benefits impact not only private individuals in terms of their health care spending and quality of life but also society in terms of publicly funded programs like Medicare and Medicaid. As a result, individuals do not personally reap many of the *social* benefits of their *personal* healthy-eating habits. However, if the private benefits of healthy eating exceed the private costs, then consumers may be sufficiently motivated to eat healthy. Because many of the benefits of healthy eating are rooted in basic human physiology, we do not have much immediate control over them—but we as a society do have the ability to change the costs of healthy eating.

When consumers eat, they are responding to perceived costs and benefits of healthy eating. Perceived costs vary from person to person and within a person over time based on financial and time constraints, where one lives and works, and one's food preferences, among other factors. Although individuals face multiple costs at once, studies to date have tended to focus on just one or a few costs faced by consumers rather than taking a comprehensive view. Future research that assesses all costs of healthy eating and the distribution of these costs across subpopulations will enhance our understanding of dietary disparities and how people make dietary choices.

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Compliance with Ethics Guidelines

Conflict of Interest Tobenna D. Anekwe currently works at USDA full-time.

Ilya Rahkovsky currently works at USDA full-time.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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- • Of importance
- •• Of major importance

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than about six hours per week if it is to work for families, and one simple and practical policy solution is to develop more labor-efficient recipes that satisfy the TFP.

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