

By Pablo Monsivais, Anju Aggarwal, and Adam Drewnowski

Following Federal Guidelines To Increase Nutrient Consumption May Lead To Higher Food Costs For Consumers

ABSTRACT The federal *Dietary Guidelines for Americans, 2010*, emphasized the need for Americans to consume more potassium, dietary fiber, vitamin D, and calcium, and to get fewer calories from saturated fat and added sugar. We examined the economic impact of meeting these guidelines for adults in King County, Washington. We found that increasing consumption of potassium—the most expensive of the four recommended nutrients—would add \$380 per year to the average consumer's food costs. Meanwhile, each time consumers obtained 1 percent more of their daily calories from saturated fat and added sugar, their food costs significantly declined. These findings suggest that improving the American diet will require additional guidance for consumers, especially those with little budget flexibility, and new policies to increase the availability and reduce the cost of healthful foods.

The federal *Dietary Guidelines for Americans, 2010*,¹ and dietary recommendations from other expert panels are evidence based. The evidence shows that diets emphasizing vegetables, fruits, whole grains, and low-fat dairy products are beneficial for health and help prevent obesity.²⁻⁵ However, Americans don't consume enough of these nutrient-dense foods, which are high in beneficial nutrients relative to their calorie content.⁶ As a result, the typical American diet includes inadequate quantities of vitamin D, calcium, potassium, and dietary fiber, along with excessive amounts of refined grains, added sugar, solid fat, and sodium.²

Such dietary imbalances have an economic dimension. Nutrient-dense foods tend to cost more than foods that are full of calories but have minimal nutritional value.^{7,8} Moreover, the prices of nutrient-dense foods have increased more rapidly over time than those of less nutritious foods.⁹⁻¹² The Dietary Guidelines Advisory Committee's report noted that economic constraints

might limit Americans' ability to follow the committee's dietary recommendations.² An analysis of the economic impact of those recommendations is in order.

We surveyed adults in King County, Washington, asking respondents about their diet. We combined dietary data with local food prices to test the hypothesis that a diet more consistent with current recommendations would cost more than the typical American diet. Specifically, we examined the cost of each incremental increase in intake for dietary fiber, potassium, calcium, and vitamin D—all recommended by the committee. We also examined the cost impact of reducing consumption of added sugar and saturated fat—two calorie sources the committee specifically recommended limiting.

The findings indicate that, particularly for those with limited food budgets, the increased cost of meeting the recommendations may be prohibitive—unless general food consumption patterns and relative food prices change.

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Pablo Monsivais (pm@u.washington.edu) is an acting assistant professor in the Department of Epidemiology and the Center for Public Health Nutrition, School of Public Health, at the University of Washington, in Seattle.

Anju Aggarwal is project manager at the Center for Public Health Nutrition.

Adam Drewnowski is director of the Center for Public Health Nutrition and a professor of epidemiology at the School of Public Health, University of Washington.

Study Data And Methods

The sampling methods and telephone survey administration were modeled on the Behavioral Risk Factor Surveillance System telephone surveys conducted by state and local health departments, as described elsewhere.^{13,14} The methods are described briefly below and in detail in the online Appendix.¹⁵

SAMPLE POPULATION Our study, the Seattle Obesity Study, was a population-based investigation of social determinants of diet quality and health conducted in 2008–09. A central hypothesis of the study was that differences in economic and physical access to healthful food would be associated with diet quality and health.

Eligible respondents were at least eighteen years old, with addresses corresponding to those listed for the landline telephone numbers at which they were reached. The survey included standard demographic and socioeconomic questions, including household income and the highest level of education completed.

Of the 2,001 adults who participated in the telephone survey, 1,318 completed a food frequency questionnaire, which we mailed them after the survey was completed. This questionnaire asked for information on usual food consumption patterns, which we used to assess dietary intakes, as described below. We excluded 23 respondents who completed the questionnaire because of the extreme calorie intakes they reported (fewer than 500 or more than 5,000 calories per day), and another 172 because of missing demographic or socioeconomic data. The final sample included 1,123 individuals (700 women and 423 men).

The age, sex, income, and education of the full Seattle Obesity Study sample ($N = 2,001$) were comparable to those in the 2007 Behavioral Risk Factor Surveillance System data for King County. The sample was also representative of the King County population (based on data from the 2000 US census) in terms of household demographics and race or ethnicity. We compared the respondents who completed the food frequency questionnaire to those who did not. The two groups did not differ significantly in terms of demographic and socioeconomic characteristics or self-reported health variables. All procedures were reviewed and approved by the University of Washington Human Subjects Division.

PARTICIPANTS' DIET We used information from the food frequency questionnaire to determine each participant's usual daily intake of nutrients and calories by food source. The questionnaire has been used in large-scale studies of population health and disease risk.^{16–19} Our analyses included all food and beverages consumed, except drinking water.

To estimate the cost of the reported diets, we added food prices to the questionnaire's nutrient composition database, as described elsewhere.^{20,21} The variable associated with each respondent's diet was the average monetary value, or cost, in dollars per day.

STATISTICAL ANALYSIS We used descriptive statistics to characterize the calorie and nutrient levels of dietary intakes among demographic groups. We used general linear models to examine the association between consumption of nutrients and tertiles of diet cost, controlling for total calories consumed and the respondent's age and sex. The tertiles were based on diet cost after adjustment for calories consumed, using the residual method.^{14,22} We used multivariate linear regression to model the monetary impact of increasing consumption of the four nutrients recommended by the Dietary Guidelines Advisory Committee, and of added sugar and saturated fat.

We expressed increases in the consumption of each of the four recommended nutrients in terms of 10 percent of the daily value for adults and children four years or older. The daily value is the daily intake level recommended by the Food and Drug Administration for purposes of nutrition labeling.²³ For added sugar and saturated fat, we scaled consumption of each to 1 percent of dietary calories. These models controlled for several covariates, as described in the Appendix.¹⁵

The regression models for potassium, calcium, vitamin D, and fiber also controlled for the diet's overall nutrient density, as shown in the Appendix.¹⁵ We used recommended limits of the American Heart Association and the World Health Organization to assess percentages of daily calories from saturated fat and added sugar, respectively.^{24,25}

LIMITATIONS Our methods imposed some limitations on our results. First, we derived nutrient and cost estimates from a food frequency questionnaire, a survey instrument that is subject to known biases—including respondents' underestimates of total calorie intake.^{26–28} However, estimates of most nutrient intakes that relied on the questionnaire we used have been reported to be within 10 percent of estimates based on other, less biased methods of dietary assessment.¹⁸

Second, the findings we report here are based on a sample of adults who were representative of King County, Washington, but not of the US population as a whole.²⁹ Third, we computed diet costs using local retail food prices at the time of data collection,^{9,11,20} which might not reflect the actual prices paid by respondents.

Finally, we followed the precedent set in the Department of Agriculture's Thrifty Food Plan,³⁰

one of three nutritious diet plans developed by the department, and the one that serves as the basis for allotments of food stamps under the department's Supplemental Nutrition Assistance Program. As in the Thrifty Food Plan, our modeling of diet cost was based on the assumption that most foods consumed, other than fast foods, were purchased at a retail store and prepared at home. Combined with the biases related to the food frequency questionnaire method, this assumption would tend to lead to a downward bias in our estimates of diet cost compared to real food expenditures.^{20,21} For these reasons, the costs described here provide a measure of the retail value of the foods consumed, not an estimate of respondents' actual food expenditures.

Study Results

The mean age of our respondents was approximately fifty-six years for both women and men. Eighty-eight percent of both men and women identified themselves as white. The rest were Asian (6.9 percent of women, 6.6 percent of men), black (4.3 percent of women, 4.0 percent of men), or other (1.7 percent of women, 0.7 percent of men). Approximately 58 percent of both women and men had earned a bachelor's degree. Household incomes corresponded to the median for King County (62.2 percent of our respondents reported annual household incomes above \$50,000). For these and other characteristics of the sample, see Appendix Table 1.¹⁵

The average daily calorie intakes were 1,714 for women and 1,991 for men. Consistent with national statistics, the average consumption of the four desirable nutrients fell short of the recommended levels. The average intakes that our respondents reported were 2,854 milligrams for potassium, 19.3 grams for dietary fiber,

5.2 micrograms for vitamin D, and 913 milligrams for calcium. Exhibit 1 shows the daily values. In contrast, the respondents' average intakes of saturated fat and added sugar exceeded recommended levels: Calories from saturated fat and added sugar accounted for 10.4 percent and 11.9 percent of total daily calories consumed, respectively. The recommended limits are also shown in Exhibit 1.

NUTRIENT CONSUMPTION AND COST OF DIET

Diet cost was associated with consumption of the four recommended nutrients, as well as of saturated fat and added sugar (Exhibit 1). Intakes of potassium, dietary fiber, and vitamin D were at least 30 percent higher in the top tertile of diet cost than in the bottom tertile. Calcium consumption showed a weaker positive association with cost. At the same time, higher-cost diets were significantly lower in saturated fat and added sugar.

It should be noted that respondents in the highest cost tertile came closer than people in the other tertiles to the daily values for all four recommended nutrients and to remaining within the recommended limits for calories from saturated fat and added sugar. In contrast, people in the lowest cost tertile had the lowest intakes of the four recommended nutrients and consumed the highest percentage of saturated fat and added sugar.

COST OF INCREASING NUTRIENT CONSUMPTION

We examined the financial effect of increasing the intake of the six nutrients, using multiple linear regression models to control for covariates. The results of these analyses are presented in Exhibit 2.

Increasing potassium consumption had the largest impact on diet cost, while increases in dietary fiber and vitamin D showed smaller but still significant impacts. In all three cases, increasing consumption led to higher cost. In con-

EXHIBIT 1

Average Nutrient Intakes Among Adults In King County, Washington, 2008-09

Nutrient	Diet cost tertile			Recommended daily value or limit
	Lowest (\$6.77/day)	Middle (\$8.58/day)	Highest (\$11.54/day)	
Potassium (milligrams)	2,391	2,758	3,243****	3,500
Dietary fiber (grams)	15.8	18.5	22.0****	25
Vitamin D (micrograms)	4.5	5.0	5.9****	10
Calcium (milligrams)	854	873	932 ^a	1,000
Added sugar (percent of calories)	13.5	11.8	10.2****	10 ^b
Saturated fat (percent of calories)	11.9	10.5	8.7****	7 ^c

SOURCE Authors' analysis of data from the Seattle Obesity Study, 2008-09. **NOTES** There were 358 respondents in the lowest cost tertile, 384 in the middle, and 381 in the highest. The tertiles are based on daily diet cost adjusted for calories using the residual method. Vitamin D is measured as the calciferol, or D3, form of the vitamin. The data are means-adjusted in general linear models containing dietary calories and respondent's age and sex as covariates. A more detailed version of this table appears the Appendix (see Note 15 in text). ^ap = 0.04. ^bLimit for added sugar from Note 24 in text. ^cLimit for saturated fat from Note 25 in text. **** p < 0.001

EXHIBIT 2

Changes In Diet Cost With Increased Intake Of Nutrients, King County, Washington, 2008–09

Nutrient (unit increase in intake)	Change in cost per unit increase in nutrient intake (\$/day)
RECOMMENDED NUTRIENTS (10% OF DAILY VALUE)	
Potassium	0.52****
Fiber	0.15****
Vitamin D	0.07****
Calcium	-0.02
OTHER NUTRIENTS (1% OF CALORIES)	
Added sugar	-0.07****
Saturated fat	-0.28****

SOURCE Authors' analysis of data from the Seattle Obesity Study, 2008–09. **NOTES** Daily values are shown in Exhibit 1. The data are based on regression models that adjusted for respondents' total calorie intake and demographic and socioeconomic characteristics. Analyses of recommended nutrients also adjusted for the overall nutrient density of the respondents' diets. A more detailed version of this table appears the Appendix (see Note 15 in text). **** $p < 0.001$

trast, increasing intakes of saturated fat and added sugar had a significant effect in the opposite direction, reducing diet cost.

Discussion

Our findings highlight a stark economic dimension to observed imbalances in diet. Based on the diets reported by a representative sample of King County, Washington, residents, our analyses indicate that people attempting to bring their diet closer to recommended consumption levels for the nutrients we studied would probably have to pay higher food costs.

Of the four nutrients that the Dietary Guidelines Advisory Committee recommended increasing, potassium was the most costly to consume at higher levels. But increasing consumption of dietary fiber and vitamin D also contributed significantly to diet cost. We found that increasing calcium intake did not have much impact on food costs. In contrast, increasing reliance on saturated fat and added sugar as calorie sources was associated with lower diet cost.

Consumption of nutrient-dense whole foods (such as whole grains, fruits, and vegetables) in order to meet nutrient requirements is a central tenet of the committee's guidelines, and it has been promoted as the basis for a healthful, varied diet.^{31–33} However, analyses of foods consumed in the United States reveal that consumers pay a premium for nutrient-dense foods.⁷ Our findings show that the committee was justifiably concerned about food costs' preventing people from following its recommendations. The economic implications of the 2010 guidelines need to be directly addressed.

For example, based on our estimates, adding

the 700 milligrams of potassium per day required to bridge the gap between the average intake reported by our respondents (approximately 2,800 milligrams) and the recommended daily value (3,500 milligrams) would increase the average adult's food costs by \$1.04 a day, or \$380 per year. The cost of increasing potassium intake to meet an even higher standard, the 4,700 milligrams per day recommended for adults by the US Dietary Reference Intake,³⁴ would be substantially more.

The results reported here represent the financial impact of changing nutrient intakes within the existing dietary habits of our sample of adults, and given current retail food prices. That impact may differ for different population groups who have different dietary habits and face different food price environments. The finding that potassium was the most costly nutrient to increase does not suggest that there are no low-cost sources of potassium, but rather that the sources of potassium in the diets of this sample tended to contribute substantially to diet cost.

The Dietary Guidelines Advisory Committee emphasized that nutrient needs should be met through food rather than supplements.² However, increasing consumption of potassium and other beneficial nutrients from food sources without increasing diet cost may require orienting consumers toward different foods than they now consume.³⁵ Our findings suggest that American consumers need dietary guidance to help them identify the most affordable food sources of potassium, fiber, and vitamin D and to incorporate them into their diets. For example, although fresh fruits are generally good sources of potassium, some provide it more economically than others. Based on our data on food prices and nutrient composition, consumers could get potassium from bananas more cheaply than from nectarines, even though nectarines contain more potassium per calorie than bananas do.

Many foods, notably vegetables and fruits, contain more than one of the recommended nutrients. For example, fresh bananas are rich in both potassium and dietary fiber. Our study analyzed the cost of increasing the consumption of each recommended nutrient separately, rather than in combination. Selecting foods that are good sources of multiple nutrients might be one way for consumers to improve overall nutrient intakes with the smallest impact on food budgets. New guidance for consumers should feature foods that offer multiple dietary benefits.

Policy Implications

One policy implication of our findings is the need to improve dietary guidance to account

for the economic dimension of nutrition. The recommendations of the federal *Dietary Guidelines for Americans, 2010*,¹ and the Dietary Guidelines Advisory Committee² are grounded in the most robust metabolic and epidemiologic evidence available. However, the goals they set do not take the potentially higher cost of more nutritious diets into account. Our findings underscore the fact that dietary recommendations need to acknowledge that food costs are a driver of consumers' food choices.³⁶ Doing so would help make dietary recommendations more realistic for all Americans, particularly for lower-income families.

A second policy implication is relevant to food and nutrition programs. Recognizing the higher cost of nutritious food, the Dietary Guidelines Advisory Committee called for financial incentives to help low-income consumers purchase vegetables, fruits, whole grains, lean meats, seafood, and other healthful foods.² And programs around the United States have demonstrated the efficacy of using financial incentives to improve the diets of families dependent on food assistance.³⁷⁻³⁹ More recent initiatives provide vouchers for produce to families on food assistance⁴⁰ or allow them to double the value of that assistance when purchasing fresh, wholesome foods from farmers' markets.⁴¹ By reducing the financial barriers to a nutritious diet, such programs may help address social disparities in nutrition.⁴²

Our findings also lead us to suggest that changes to the US food production and distribution system overall are in order. The current system has proved to be remarkably effective in the provision of calories, but not as good at supplying nutrients.⁴³ More fundamentally, the system currently falls short of producing enough vege-

tables and fruit to supply Americans with even the minimum recommended number of daily servings of these foods.⁴⁴

Public health goals, including the achievement of recommended dietary targets, must be central in the formulation of agriculture and trade policies.⁴⁵ The next reauthorization of the Farm Bill, scheduled for 2012, will be one opportunity to implement such changes. For example, reorienting agricultural subsidies and other incentives to support the production and distribution of vegetables and fruit would be an important step toward making these foods more available and affordable.

Conclusion

The federal *Dietary Guidelines for Americans, 2010*,¹ like other broad dietary recommendations for the American public, are grounded in research indicating that a nutrient-dense diet confers a number of health benefits. However, our findings indicate that adopting a nutrient-dense diet in line with both dietary recommendations and current US eating habits may raise food costs for consumers.

Dietary recommendations need to become more sensitive to the economic constraints faced by consumers, particularly those in the most vulnerable segments of society, who bear a disproportionate burden of obesity and chronic disease. At the same time, food and agriculture programs and policies should be reexamined from the perspective of public health—including the health benefits that could be achieved if more Americans' diets were consistent with the committee's guidelines. ■

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NOTES

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ABOUT THE AUTHORS: PABLO MONSIVAIS, ANJU AGGARWAL & ADAM DREWNOWSKI



Pablo Monsivais is an acting assistant professor at the University of Washington.

In their article in this month's *Health Affairs*, Pablo Monsivais and colleagues demonstrate that observing new federal dietary guidelines may boost consumers' food costs substantially—especially to gain enough nutrients such as potassium and fiber. The team's findings, based on the costs of meeting the guidelines in King County, Washington, underscore the need "to find ways to make more nutritious foods more economically accessible," Monsivais says.

Monsivais is an acting assistant professor in the Department of Epidemiology and Center for Public Health Nutrition, School of Public Health, at the University of Washington. His research focuses on why people eat what they do, when they eat, and how much they eat, with an emphasis on population-level determinants. He is particularly interested in the

pathways linking socioeconomic status with diet quality and the impact and efficacy of nutrition and social policy on diet and health. Monsivais earned a doctorate in neurobiology and behavior and a master of public health degree at the University of Washington.



Anju Aggarwal is project manager at the Center for Public Health Nutrition, University of Washington.

Anju Aggarwal is project manager for the Seattle Obesity Study at the University of Washington's Center for Public Health Nutrition. Her primary area of research is access to food—both physical and economic—and how access may contribute to disparities in diet, nutrition, and health. The recent recipient of a doctorate in human nutrition from the Johns Hopkins Bloomberg School of Public Health, Aggarwal earned a master's degree in foods and nutrition at Delhi University, in New Delhi, India.



Adam Drewnowski is director of the Center for Public Health Nutrition and a professor at the University of Washington.

Adam Drewnowski is director of the Center for Public Health Nutrition and of the Center for Obesity Research at the University of Washington. He also is a professor of epidemiology at the university's School of Public Health and director of the graduate program in nutritional sciences. His extensive research has helped develop new methods and measures for exploring the links between obesity and social disparities and between diet quality and diet cost. A member of the Standing Committee to Prevent Childhood Obesity at the Institute of Medicine, Drewnowski obtained a doctorate in psychology from the Rockefeller University and a master's degree in biochemistry from Balliol College, University of Oxford, in England.