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Following federal guidelines to increase nutrient consumption may lead to higher food costs for consumers

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Abstract

The 2010 Dietary Guidelines Advisory Committee emphasized the need to increase dietary intakes of potassium, dietary fiber, vitamin D, and calcium. Examining the economic impact of increasing intakes of these nutrients to recommended levels among adults in King County, Washington, we found that each increase in intake of potassium, dietary fiber, and vitamin D equal to 10 percent of the daily target intake significantly increased food costs to consumers. At the same time, each time consumers obtained 1 percent more of their daily calories from added fats and added sugars, their food costs significantly declined. These findings suggest that many consumers, especially those with little budget flexibility, will need assistance to adopt healthier diets consistent with federal goals.

Introduction

American diets do not conform to dietary recommendations from the US Department of Agriculture and other expert panels (1-5). These recommendations are based on research showing that diets emphasizing vegetables, fruit, whole grains and low-fat dairy products are beneficial for health and the prevention of obesity. The 2010 Dietary Guidelines Advisory Committee reported that Americans consume inadequate quantities of these nutrient dense foods, which are high in beneficial nutrients relative to their calorie content, placing individuals at particular risk for inadequate intakes of vitamin D, calcium, potassium, and dietary fiber (3). Moreover, American diets contain excessive amounts of refined grains, added sugars, solid fats, and sodium.

Such dietary imbalances have an economic dimension. Nutrient dense foods tend to cost more than calorie dense foods of minimal nutritional value (6, 7). Moreover, nutrient dense foods have increased in price disproportionately over time, compared to less nutritious foods (8-11). The economic feasibility of reaching federal dietary goals, including the food consumption patterns and target nutrient intakes issued in the 2010 Dietary Guidelines, is therefore a cause for concern. Indeed, the Dietary Guideline Advisory Committee's report explicitly acknowledged that economic constraints might limit the ability of Americans to

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achieve dietary recommendations (3). An economic impact analysis of the 2010 Dietary Guidelines is in order.

We used a unique, population-based survey of adult dietary intakes in Seattle-King County, Washington, combined with local food prices, to explore the possibility that a diet more consistent with current recommendations would be less affordable to the consumer. Specifically, we examined the cost of each incremental increase in intake for the four nutrients encouraged by the Advisory Committee: dietary fiber, potassium, calcium and vitamin D. We also examined the cost impact of changing intake of two calorie sources the committee recommends limiting: added sugars and saturated fat. The findings indicate that, particularly for those with constrained food budgets, the increased cost of meeting recommendations may be prohibitive – so long as the general food consumption patterns and relative food prices observed remain unchanged.

METHODS

The sampling methods and telephone survey administration were modeled on the Behavioral Risk Factors Surveillance System (BRFSS) telephone surveys conducted by state and local health departments, as previously described (12, 13). All methods are described in brief below but provided in detail in the Appendix[14].

Participant Sample

The Seattle Obesity Study (SOS) was a population-based study of social determinants of diet quality and health conducted in 2008-2009. A central hypothesis of the SOS was that differences in food access and food spending would be associated with diet quality and health.

Eligible respondents were at least 18 years of age, with addresses corresponding to the landline telephone numbers at which they were reached. The telephone survey included standard demographic and socioeconomic questions, including highest level of education completed and household income.

Of 2,001 adults who participated in the telephone survey, 1,318 completed a food frequency questionnaire. This questionnaire provided information on usual food consumption patterns, and was used to assess dietary intakes (see below). Of those respondents completing the food frequency, 23 were excluded based on their extreme calorie intakes (less than 500 or more than 5000 calories per day), and 172 were excluded due to missing demographic or socioeconomic data. The final sample included 1,123 individuals (700 women and 423 men).

The full SOS sample (n=2,001) was comparable to the 2007 Behavioral Risk Factor Surveillance System data for King County, in terms of key demographic and socioeconomic characteristics, namely age, gender, income and education. The sample was also representative of the King County population (based on year 2000 Census data) in terms of household demographics and race/ethnicity. Out of 2,001 respondents, those who completed the food frequency questionnaire were compared to those who did not and were not found to

be significantly different in terms of demographic and socioeconomic characteristics and self-reported health variables. All procedures were reviewed and approved by the University of Washington Human Subjects Division.

Dietary Intake Assessment

Each participant's usual daily intake of nutrients and calories by food source was determined and assessed using information from the food frequency questionnaire. The food frequency questionnaire used in this study has been used previously in large scale studies of population health and disease risk (15-18). All foods and beverages consumed, except drinking water, were included in the analyses.

Monetary value of diets

The cost of the reported diets was estimated by attaching a food price vector to the food frequency questionnaire's nutrient composition database, as described previously (19, 20). The variable associated with each respondent's diet was the average monetary value in dollars per day.

Statistical analysis

Descriptive statistics were used to characterize the calorie and nutrient levels of dietary intakes among demographic strata. General Linear Models were used to examine the association between diet cost tertiles and nutrient intakes, controlling for total calories consumed and the respondent's age and gender. Tertiles were based on diet cost after adjustment for calories consumed using the residual method (13, 21). Multivariate linear regression was used to model the monetary impact of increasing intakes of the four nutrients to encourage, added sugars and saturated fat. For the four nutrients to encourage, intakes for each were scaled to ten percent of the Daily Value for adults and children 4 years and older. The Daily Value is a recommended daily intake level defined by the US Food and Drug Administration (22) for purposes of nutrition labeling. For the nutrients to limit, intakes were scaled as 1 percent of dietary calories. These models controlled for several covariates, as described in the Appendix. The regression models for potassium, calcium, vitamin D and fiber also controlled for the overall nutrient density of the diet (see Appendix).

Methodological Limitations

These methods impose some limitations. First, nutrient and monetary estimates were derived from a food frequency questionnaire, a survey instrument that is subject to known biases, including underestimating total calorie intake (23-25). Estimations of most nutrient intakes by the questionnaire used here have been reported to be within 10 percent of estimations based on other, less biased methods of dietary assessment (17). Second, the present findings were based on a sample of adults who were representative of King County, Washington, but not of the US population as a whole (26). Third, diet costs were computed using local retail food prices at the time of data collection (8, 10, 19), which might not properly reflect the actual prices paid by individuals. Finally, following the precedent set in the U.S. Department of Agriculture's Thrifty Food Plan (27), the present modeling of diet cost was based on the assumption that most foods consumed, other than fast foods, were purchased at retail and

prepared at home. This combined with the biases related to the food frequency questionnaire method would tend to lead to a downward bias in our diet cost estimations compared to food expenditures (19, 20). For these reasons, the monetary variable described here provides a measure of the retail value of foods consumed, not an estimate of actual food expenditures.

RESULTS

The mean age of respondents was approximately 56 years for both women and men. Eighty-eight percent of 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 (1.3 percent). Approximately 58 percent of women and men had completed a bachelor's degree or higher. Household incomes corresponded to median incomes of King County (62.2 percent reported incomes above $50,000/year). Sample characteristics are provided in Appendix Table 1.

Average daily calorie intakes were 1,714 for women and 1,991 for men. Consistent with national statistics, average intakes of the four nutrients to encourage all fell short of recommendations: 2854 milligrams for potassium (Daily Value 3,500 milligrams); 19.3 grams for dietary fiber (Daily Value 25 grams); 5.2 micrograms for vitamin D (Daily Value 10 micrograms); and 913 milligrams for calcium (Daily Value 1000 milligrams). By contrast, average intakes of sugars and fats exceeded recommendations. Calories from saturated fats and added sugars accounted for 10.4 percent of calories and 11.9 percent of total daily calories consumed, respectively.

Nutrient intakes and diet costs

Diet cost was systematically associated with intakes of the four nutrients to encourage, added sugar and saturated fat. **Exhibit 1** shows adjusted mean nutrient intakes across tertiles of calorie-adjusted diet cost. Intakes of potassium, dietary fiber and vitamin D were at least 30 percent higher in the top tertile of diet cost compared to the lowest tertile ($p < 0.001$ for all three nutrients). Calcium 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 strata came closest to satisfying the daily values for potassium, fiber, vitamin D and calcium, and to remaining within the recommended limits for calories from saturated fat and added sugars. By contrast, persons in the lowest cost strata had the lowest intakes of the four nutrients to encourage but exceeded the upper limits for saturated fat and added sugars.

Quantifying the cost of increasing nutrient intakes

The monetary effect of increasing intake of the six nutrients was examined using multiple linear regression models to control for covariates. The results of these analyses are presented in **Exhibit 2**, which shows the change in diet cost associated with each incremental increase in intake of each nutrient. Potassium showed the largest impact on diet cost. Each increase in potassium intake equal to 10 percent of the daily value (350 milligrams) was associated with an increase in diet cost of $.52 per day ($p < 0.001$). Increases in dietary fiber and vitamin D showed smaller but still significant impacts on diet cost. Increasing dietary fiber and vitamin

D by 10 percent of the daily value was associated with increases in diet cost of $.15/day and $.07/day, respectively ($p < 0.001$ for both). Increasing calcium did not have a significant effect on diet cost (-$.02, $p = 0.21$).

While increasing intakes of three of the four nutrients to encourage was associated with higher diet cost, increasing intakes of the calorie sources to limit was associated with lower diet cost. Each 1 percent increase in daily calories from saturated fat was associated with a $.28 reduction in diet cost ($p < 0.001$), while each 1 percent increase in calories from added sugars was associated with a $.07 reduction in diet cost ($p < 0.001$).

DISCUSSION

The present findings highlight a stark economic dimension to observed imbalances in the diet. The current analyses, based on the diets reported by a representative sample of King County, Washington residents, indicate that – given current local food consumption patterns – individuals attempting to redress the observed imbalances would likely bear higher food costs. Of the four nutrients to encourage targeted by the Dietary Guideline Advisory Committee, potassium was the most costly to consume at higher levels, but higher dietary fiber and vitamin D intakes also contributed significantly to diet cost. In contrast, increasing reliance on saturated fat and added sugars as calorie sources was associated with decreased 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 Dietary Guidelines, and has been promoted as the basis for a healthful, varied diet (28-30). However, analyses of foods consumed in the US reveal a price premium for nutrient dense foods (6). The Dietary Guidelines Advisory Committee was justifiably concerned that food costs could pose a barrier to consuming diets more in keeping with its recommendations. Therefore, the economic implications of the proposed 2010 Dietary Guidelines need to be directly addressed.

For example, based on our estimates, obtaining the additional 700 milligrams/day of potassium from the diet required to bridge the gap between the current average intake (approximately 2,800 milligrams/day) and the recommended (Daily Value, 3,500 milligrams/day) would increase average individual food costs by $1.04 a day or $380 per year. The cost of achieving an even higher target potassium intake, the U.S. Dietary Reference Intake (4,700 milligrams/day for adults), would be substantially more.

The findings reported here represent the monetary impact of changing nutrient intakes within the existing dietary habits of this sample of adults and given current retail food prices. That monetary impact may differ for different population groups with different dietary habits and who face different food price environments. The present finding that potassium was the most costly nutrient to increase in the diet 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. Increasing intakes of potassium and other beneficial nutrients from food sources without increasing diet cost may require

reorienting consumers toward a different mix of foods than those currently consumed (31). Based on the present findings, dietary guidance should help consumers identify and incorporate the most affordable food sources of potassium, fiber and vitamin D into their diets.

Policy Implications

The need to improve dietary guidance to account for the economic dimension of nutrition is one policy implication of the present findings. While the Dietary Guidelines for Americans are grounded in the most robust metabolic and epidemiologic evidence available, they do not account for the potentially higher cost of more nutritious diets. Nutrition guidance, including the Dietary Guidelines, needs to acknowledge that food costs are a driver of consumer food choices (32). Doing so will help make the Dietary Guidelines more relevant for all Americans, particularly for lower-income families.

Nutrition guidance should maintain its emphasis on meeting nutrient needs through foods rather than supplements (28, 29), but guidance should also help consumers identify the most affordable sources of key nutrients. For example, while fresh fruits are in general good sources of potassium, some provide potassium more economically. Based on our food price and nutrient composition data, bananas were the most affordable in this respect while blueberries were the most costly.

A second policy implication is for food and nutrition programs. The DGAC Report, recognizing the higher cost of nutritious foods, called for financial incentives to help low-income consumers purchase vegetables and fruit, whole grains, lean meats, seafood and other healthful foods (3). To this end, programs around the US have demonstrated the efficacy of targeting monetary incentives to families dependent on food assistance (33-35). More recent initiatives provide produce vouchers to families on food assistance (36) or allow them to double the value of their benefit when purchasing fresh, wholesome foods from farmers markets (37). By reducing the monetary barrier to nutritious food, such programs may help address social disparities in nutrition (38).

Our findings also lead us to suggest that systemic changes to the food system are in order. The current system of agricultural production and food distribution has proven remarkably effective in the provision of calories but not nutrients (39). More fundamentally, the system currently falls short of producing enough vegetables and fruits to supply Americans with even the minimum recommended number of servings of these foods (40). Public health goals must be central in the formulation of agriculture and trade policy (41). 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 fruits would be a critical step toward making these foods more available and affordable.

Conclusions

A nutrient dense diet offers a number of established health benefits. However, adopting a diet that is in line with dietary guidelines and eating habits may raise food costs for consumers. Dietary recommendations need to become more sensitive to the economic

constraints of consumers, particularly to the most vulnerable segments of society who bear the 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.

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Exhibit 1

Average nutrient intakes among adults in King County, Washington, 2008-2009[a].

n =	Lowest 358	Diet Cost Group Middle 384	Highest 381	Daily Value or Limit
Diet cost ($/day)	6.77	8.58	11.54	
Potassium (milligrams)	2391	2758	3243**	3,500
Dietary Fiber (grams)	15.8	18.5	22.0**	25
Vitamin D[b] (micrograms)	4.5	5.0	5.9**	10
Calcium (milligrams)	854	873	932*	1000
Added sugars (percent of calories)	13.5	11.8	10.2**	10[d]
Saturated fat (percent of calories)	11.9	10.5	8.7**	7[c]

Means adjusted in general linear models containing dietary calories and respondent's age and gender as covariates.

[a] Three levels based on daily diet cost adjusted for calories (dietary energy)using the residual method.

[b] As calciferol.

[c] Limit for saturated fat from the American Heart Association.

[d] Limit for added sugars from the World Health Organization.

* Indicates trend test P = 0.04; .

** P < 0.001. Data from the Seattle Obesity Study, 2008-09. A more detailed version of this table appears the Appendix.

Table 2

Change in diet cost with increased intake of nutrients, King County, Washington, 2008-09[a].

Nutrient (unit increase in intake)	Change in Diet Cost per unit increase in nutrient intake *($/day)*
Nutrients to Encourage [b]	
(10% of Daily Value[c])	
Potassium	0.52*
Fiber	0.15*
Vitamin D	0.07*
Calcium	−0.02
Nutrients to Limit	
(1 % of dietary calories)	
Added sugars	−0.07*
Saturated Fats	−0.28*

[a] Based on regression models that adjusted for total calorie intake, demographics and socioeconomic indicators.

[b] Analyses of these nutrients also adjusted for the overall nutrient density of the diet (see Appendix).

[c] For daily values, see Exhibit 1.

* Indicates $p < 0.001$. Data from the Seattle Obesity Study, 2008-09. A more detailed version of this table appears the Appendix.