Research Article

Total Usual Intake of Shortfall Nutrients Varies With Poverty Among US Adults

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ABSTRACT

Objective: To examine shortfall nutrient intakes (ie, calcium, folate, potassium, magnesium, and vitamins A, C, D, and E) by poverty-to-income ratio (PIR).

Design: National Health and Nutrition Examination Survey 2011–2012, a nationally representative, cross-sectional survey.

Participants: US adults with complete data on poverty status and diet were included (n = 4,524).

Analysis: The National Cancer Institute method was used to estimate total usual micronutrient intakes from foods, beverages, medications, and dietary supplements reported on 2 24-hour dietary recalls using measurement error correction.

Main Outcome Measures: Calcium, folate, potassium, magnesium, and vitamins A, C, D, and E across 3 PIR categories: <130%, 130% to 350%, and ≥350%.

Results: Mean intakes of folate, vitamin C, and vitamin D were significantly greater in men, and magnesium in women, across all PIR categories. Except for calcium in men and vitamin C in women, the highest PIR category had significantly higher mean total usual intakes of all remaining shortfall micronutrients. Importantly, men and women in the highest PIR category (≥350%) were significantly less likely to have intakes below the Estimated Average Requirement across all micronutrients compared with those in the lower PIR categories.

Conclusions and Implications: Even with dietary supplements, large proportions of US adults have micronutrient intakes below the Estimated Average Requirement. Adults at the highest adjusted income have higher micronutrient intakes and lower risk of inadequacy than those with lower incomes.

Key Words: micronutrients, vitamins, minerals, diet quality, NHANES, dietary supplements, poverty, shortfall nutrients (*J Nutr Educ Behav*. 2017;49:639-646.)

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INTRODUCTION

The National Health and Nutrition Examination Survey (NHANES) monitored indicators of nutrition and health for the past 50 years, and trends have been identified using the multitude of sequential, cross-sectional reports. First, the quantity and variety of food available to Americans has increased over time, leading to considerable changes in dietary intakes.[1] Second, total energy consumption, portion size, and foods consumed away from the home have increased over time.[2-4] Third, a substantial proportion of the US population does not meet federal nutrition standards for most nutrient-dense food groups although it overconsumes energy-dense and empty calories.[5,6] Fourth, dietary supplement use has increased over time.[7] Finally, prevalence of food-related poverty and food insecurity has increased.[8] Although no causal inferences can be drawn from cross-sectional monitoring data, these food and economic trends have occurred concurrently with higher rates of obesity and deserve careful evaluation.[9-12]

It is well established that nutrient-rich foods tend to be more expensive than lower-quality foods.[13-15] Although the cost of food in the US is less than that in other similarly developed countries,[16] people with lower incomes are more likely to have lower nutrient-dense diets[17] and to devote a larger proportion of the family income toward food purchases than are individuals with higher incomes.[18] The proportion of Americans living in poverty in the US increased from 12.2% in 2000 to 14.8% in 2014.[19,20] Dietary supplement use has been shown to be highest among the most affluent population[21,22];

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paradoxically, adult supplement users have better micronutrient intakes from the diet.[23,24] However, little is known about how poverty affects diet quality in terms of micronutrient intakes with the inclusion of dietary supplements at the national level. Therefore, the purpose of this study was to examine micronutrient intakes by poverty-to-income ratio (PIR) among US adults, using data from the most recent 2011–2012 NHANES.

METHODS

Study Design, Participants, and Setting

Collected by the Centers for Disease Control and Prevention, National Center for Health Statistics, NHANES is a cross-sectional survey using a stratified, multistage probability design to obtain a nationally representative sample of the civilian, noninstitutionalized US population.[25] Data from the 2011–2012 NHANES were used for these analyses. The analytic sample included nonpregnant, adult participants (aged ≥19 years) who had complete PIR (n = 4,524) and 24-hour dietary intake data. Written, informed consent was obtained for all participants or proxies. Review by the institutional review board was not required for this study because the survey protocol was approved by the Research Ethics Review Board at the National Center for Health Statistics and the data are public access.

The NHANES protocol includes an in-home interview, a health examination in a mobile examination center, and a follow-up telephone call about 3–10 days after the examination. Demographic data, including age, gender, education, and race/ethnicity, were collected via computer-assisted software in the home interview. The PIR is a measure that represents the ratio of household income to the poverty threshold after adjusting for geographic location and family size, developed by the Department of Health and Human Services. Three PIR categories were constructed: <130%, 130% to 350%, and ≥350%. A PIR <130% is the income eligibility criterion for participation in the *Supplemental Nutrition Assistance Program* (SNAP) (the former *Food Stamps Program*), and these cutoff points were previously used in NHANES analyses because they were shown to differentiate among health, dietary supplement use, and nutrition indicators.[10,21,26,27]

Dietary data in NHANES came from the US Department of Agriculture,[28] Agricultural Research Service, What We Eat in America survey and were collected using the automated multiple-pass method.[29,30] Two 24-hour dietary recalls were collected, including the use of dietary supplements. The first recall was collected in person at the household interview; the second recall was collected via telephone. Both week and weekend days were obtained to ensure representativeness. The US Department of Agriculture, Food and Nutrient Database for Dietary Studies was used to convert foods and beverages, as reported, to their respective nutrient values.[31] The researchers examined selected shortfall micronutrients for adults identified by the Dietary Guidelines for Americans: calcium (milligrams), folate (dietary folate equivalents), magnesium (milligrams), potassium (milligrams), vitamin A (retinol activity equivalents), vitamin C (milligrams), vitamin D (micrograms), and vitamin E (α-tocopherol equivalents).

A dietary supplement questionnaire was administered during the household interview, including showing containers to the trained interviewers to enhance accuracy.[25] The time frame for the questionnaire was over the previous 30 days. For each dietary supplement the respondent reported, she or he was asked to report the consumption frequency, the dose, and the duration of use. The National Center for Health Statistics provided the average daily intake of nutrients from all dietary supplements and medications that may contain nutrients (eg, antacids) as calculated for individuals using the number of days supplement use was reported, the reported amount taken per day, and the serving size unit from the product label. Vitamins A and E from dietary supplements were not available in this survey cycle. Potassium is rarely an ingredient in dietary supplements; if it present, it is found only in very small amounts (<15 mg).[32,33]

Data Analysis

All data analyses were performed using SAS software (version 9.4; SAS Institute, Inc, Cary, NC, 2016). Sample weights were used to account for differential nonresponse and/or no coverage and to adjust for planned oversampling of some groups. Prevalence of dietary supplement use was estimated overall and by sex using *proc surveymeans*. Estimates of usual intake for each micronutrient were determined using the National Cancer Institute (NCI) method[34,35] macros that produce means and percentiles of intake and probabilities of meeting the Estimated Average Requirement (EAR) for all adults with data from the 24-hour recalls (n = 4,524). The macros used in this analysis were specifically developed to address how dietary supplement use affects usual intake estimates incorporating information about dietary supplements from both the 24-hour and 30-day frequency questionnaires; these macros were previously used to estimate total nutrient intakes.[36,37] The probability approach was used to estimate compliance with the EAR for all nutrients with an established value (ie, all shortfall nutrients except potassium). Covariates in the usual intake models included PIR (dummy coded), day of the week of dietary recall (weekend/weekday), interview sequence of the dietary recall, and dietary supplement use. To estimate total usual nutrient intake, nutrient intakes from dietary supplements were added to the adjusted usual nutrient intake from foods, as recommended.[38] Percent contributions of dietary supplements to total intakes were calculated by sex and PIR. Users and nonusers of dietary supplements were also examined independently. The researchers used multiple *t* tests to compare mean intakes and EAR compliance within sex by PIR group, with a Bonferroni-corrected significant *P* set at ≤.005.

RESULTS

The PIR category was classified as <130% (A = lowest), 130% to 350% (B = middle), and ≥350% (C = highest). The prevalence of dietary supplement use increased significantly in a stepwise fashion with PIR category for all adults and for both men and women (Table 1). Women had higher reported use of a dietary supplement than did men across all PIR categories.

Total usual mean intakes of several micronutrients varied by PIR category