The Nutrition Status of HIV-infected U.S. Adults

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Footnotes to the title:

[1] Abbreviations used: ART, antiretroviral therapy; AIDS, acquired immune deficiency syndrome; BMI, body mass index; HIV, human immunodeficiency virus; MEC, mobile examination center; NCHS, National Center for Health Statistics; NHANES, National Health and Nutrition Examination Survey; PIR, poverty income ratio;

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Abstract

Background: Nutrition is critical to HIV mortality and morbidity. Improved treatment modalities have increased life expectancy of HIV-infected individuals. More than one million U.S. adults are living with HIV; but, little is known about their nutritional status.

Objective: We aimed to characterize the nutritional status of those living with HIV using the National Health and Nutrition Examination Survey (NHANES) 2003-2014.

Methods: The NHANES is a nationally-representative, cross-sectional survey of the U.S. population and includes a household interview, medical examination, and two 24-hour dietary recalls; survey weights are applied to make the data nationally-representative. HIV antibodies were ascertained initially by immunoassay and confirmed with Western Blot. NHANES 2003-2014 data were analyzed for HIV-positive (n= 87) and HIV-negative (n= 15,868) U.S. adults (19-49y). BMI, waist circumference, dietary intakes, and nutritional biomarkers were estimated and compared by HIV status, stratified by sex.

Results: HIV infected men and women had higher serum protein, lower serum albumin, and lower serum folate than non-HIV infected adults. HIV-positive women had significantly higher BMI, prevalence of overweight/obesity, and waist circumference risk and substantially lower serum-25-(OH) vitamin D (44 vs 65 nmol/L) than HIV-negative women. When compared with HIV-negative women, HIV-positive women had lower intakes of some key nutrients like fiber, vitamin E, vitamin K, magnesium, and potassium, and but had higher intakes of protein and niacin.

Conclusion: The NHANES data suggest that HIV infection is associated with poorer markers of some nutritional status indicators. However, the U.S. population prevalence of HIV is < 0.5%.; given the small sample size, not only in this study but also in the U.S., much more targeted research is needed to better understand the multitude of factors that influence the nutritional status among those living with HIV in the U.S., especially among women.

Keywords: HIV, Nutrition, obesity, biomarker, NHANES

Introduction

Poor nutrition status can both be a cause of and exacerbate infection and inflammation (1); nutrition is an independent predictor of mortality among those with HIV infection (2, 3). The malnutrition of HIV has been associated with various factors: increased likelihood of food insecurity, high costs of prescription medications, nutrient-drug interactions, weight loss due to diarrhea and vomiting, alterations in metabolism and absorption of nutrients, and increased caloric requirements (4, 5). Medical advances in treatment of HIV/AIDS, like antiretroviral therapy (ART), have dramatically improved HIV survival rates and also reduced many of the acute malnutrition-related concerns associated with the disease. Meanwhile, with increased life expectancy, people living with HIV are now facing the challenges of chronic diseases. HIV-positive adults were reported to have higher risks of metabolic syndrome, cardiovascular disease, and type 2 diabetes, which has the potential to be reduced with optimal nutrition (6-8). Thus, public health concerns over nutrition and HIV have shifted from acute malnutrition to providing optimal nutrition to enhance the quality of life and health of infected individuals (9).

Currently about 1.2 million Americans are living with HIV (10-12), but very little is known about the nutritional status of those living with HIV in the U.S. that is national in scope. The purpose of this analysis was to characterize the nutritional status of those living with HIV in the U.S. using the National Health and Nutrition Examination Survey (NHANES) 2003-2014, a nationally-representative cross sectional survey of the health and nutrition status of Americans.

Methods

NHANES is a cross-sectional survey of the noninstitutionalized, civilian U.S. resident population conducted to assess the health and nutrition status of U.S. population (13). The survey is conducted by the National Center for Health Statistics (NCHS), Centers for Disease Control and Prevention. All study methods are approved by the NCHS research ethics review board. All participants provided informed consent. NHANES participants are selected using a complex multistage sampling design (14). The NHANES survey includes an in-home health interview, a physical examination in a mobile examination center (MEC), and a follow-up telephone interview. This analysis includes data from NHANES 2003-2014, from all non-pregnant adult participants aged 19-49 years who did not refuse the HIV antibody testing, representing a total of both HIV-positive (n= 87) and HIV-negative (n= 15,868) adults.. Participants up to the age of 49 years were eligible for the HIV testing from 2003-2008 and participants up to the age of 59 years were eligible from 2009-2014. For consistency, we limited the sample size to the corresponding age range in the earlier years.

Demographic data was collected during the interview in participants' home via a computer-assisted personal interview interviewer-administered questionnaire. Across most NHANES cycles, self-reported race/ethnicity is categorized as non-Hispanic white, non-Hispanic black, Hispanic and Mexican American, and "other". Education was dichotomized as less than high school or high school diploma/GED/or higher than high school. The poverty to income ratio (PIR) is a measure that represents the ratio of household income to the poverty threshold after adjustments for geographic location and family size, developed by the Department of Health and Human Services.

Three PIR categories were constructed: < 130%, 130% - 350%, ≥ 350%. A PIR less than 130% is the income eligibility criterion for participation in the Supplemental Nutrition Assistance Program (SNAP; i.e. the former Food Stamps Program), and these cutoff points have been previously used in NHANES analyses because they have been shown to differentiate between health and nutrition indicators (15).

Height and weight were measured during health examination at the MEC and BMI was calculated as weight (kg)/height (m^2). Participants' were classified as non-overweight/obese (BMI < 25 kg/m^2) or overweight/obese (BMI ≥ 25 kg/m^2). Waist circumference was measured at the uppermost lateral border of the iliac crest using a tape measure (16). Waist circumference risk was calculated using National Institutes of Health Guidelines: > 88 cm for women and > 102 cm for men (17).

During the examination, a blood sample was drawn by trained phlebotomist from all participants' who did not refuse the HIV antibody test. HIV status was ascertained based on the presence of antibody to HIV in blood (using Synthetic Peptide Enzyme Immunoassay (EIA) technique for HIV -1 or HIV-2 or both). Specimens that were reactive in the initial screening were retested in duplicate with the Genetic Systems HIV-1/HIV-2 Peptide EIA. Specimens that were reactive in either one or both of the duplicates were then tested again for confirmation using Western Blot technique. A limited number of nutritional biomarkers with sufficient survey years available for analysis were available. Therefore this analysis was limited to serum protein, serum albumin, total cholesterol, triglycerides, serum glucose, vitamin D (25-hydroxyvitamin D) (NHANES 2003-2010), and serum and red blood cell (RBC) folate (NHANES 2003-2012); differences in analytical methods across survey years were standardized as recommended by NCHS. A timed rate biuret method, a bichromatic digital endpoint method and the timed-endpoint method were used to measure the concentrations of total protein, albumin, and cholesterol respectively using the DxC Synchron Clinical Systems. Modified microbiological assay method was used for measuring RBC folate. Diluted whole blood sample was added to an assay medium containing Lactobacillus casei (NCIB 10463) and all of the nutrients necessary for the growth of L. casei, except folate. Since the growth of L. casei is proportional to the amount of total folate present in the sample, the total folate level was assessed by measuring the turbidity of the inoculated medium in a PowerWave X340 Microplate reader (Bio-Tek Instrument). Serum folate was measured using isotope-dilution high performance liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS). Ultra-high performance liquid chromatography-tandem mass spectrometry (UHPLC-MS/MS) was used for measuring vitamin D concentration. Detailed laboratory methods are publicly available (18).

Two 24-hour dietary recalls were collected using the USDA's Automated Multiple-Pass Method (19, 20). The first 24-hour recall was collected in person during the health examination. The second was collected via telephone. The NHANES protocol attempts to have even distribution of weekdays and weekend days. The USDA Food and Nutrient Database for Dietary Studies was used to convert foods and beverages as reported to determine their respective energy and nutrient values. The dietary data are presented for individuals with complete data on both dietary recalls. The average of nutrient intakes from both dietary recalls was calculated. Supplement use was classified as any dietary supplements taken during the past month.

All statistical analysis were performed using SAS software (version 9.4; SAS Institute Inc, Cary, NC) and SAS-callable SUDAAN software (version 11.0; RTI International; Research Triangle, NC). The sample design includes oversampling in order to obtain reliable estimates of health and nutritional measures for population subgroups. Sample weights, which account for differential probabilities of selection, non-response and non-coverage, were calculated for 12 years for the examination and dietary data in order to produce unbiased national estimates. Means were estimated for BMI, dietary components, and biomarkers by HIV status within sex and by sex within HIV status for infected adults using contrast statements in proc descript. Standard error of the mean (SE) estimates were calculated using Taylor series linearization. The relative standard error (RSE) was calculated for each estimate and the estimates with RSEs greater than 40% could be interpreted as statistically unreliable (12). Statistical significance was set at $p < 0.05$.

Results

HIV infection represented <0.5% of the U.S. adult population in NHANES 2003-2014 (data not shown). Men had a higher prevalence of HIV than women (77% vs 23%), and non-Hispanic Blacks were more likely than other race/ethnic groups to be HIV positive (**Table 1**). The mean age of HIV-positive individuals was slightly higher (37.7 y) than negative individuals (34.3 y). Educational attainment did not differ by sex within infected individuals or between infected and non-infected adults when sex was combined. Most infected adults were at < 350% of the PIR; none of the HIV positive women belonged to the ≥ 350% PIR category compared to 38% non-infected women. There was no consistent or significant pattern of marital status in infected adults, though the distributions differed from that of the non-infected U.S. adult population.

HIV-positive women had significantly higher BMI (34.3 kg/m^2; SE 2.3) when compared with both HIV-negative women (28.4 kg/m^2; SE 0.1) and HIV-positive men (26.2 kg/m^2; SE 0.7) (**Table 2**). HIV-positive men had a significantly lower BMI than HIV-negative men (28.3 kg/m^2; SE 0.1). Indeed, the percentage of those who are overweight or obese was significantly higher for HIV-positive women compared to both HIV-negative women and HIV-positive men, and significantly lower for HIV-positive men compared to HIV-negative men. The similar trend was found with regard to waist circumference, and the percentage of those at metabolic risk based on waist circumference.

Consistent in both sexes, HIV infected adults had higher serum protein, lower serum albumin, and lower serum folate than non-HIV infected adults. No significant differences were observed for triglycerides, glucose, or RBC folate within sex by HIV status or within HIV infected individuals by sex. HIV-positive men had lower level of total cholesterol than HIV-negative men (4.7 vs. 5.0 mmol/L). HIV-positive women had substantially lower serum-25-(OH) vitamin D (43.7 vs 64.9 nmol/L) than HIV-negative women.

No differences in energy intake were observed within sex by HIV status (**Table 3**). HIV positive women had significantly different intakes of fiber (9.2g; SEM 1.5 vs. 14.7g; SEM 0.2) and protein (83.5g; SEM 6.1 vs. 71.3g; SEM 0.5) than HIV negative women. Among men, no significant differences in dietary intakes were observed by HIV status except for vitamin B6, which was lower in HIV-positive men when compared to HIV-negative men. Whereas, compared with HIV-negative women, HIV-positive women had higher intakes of niacin and lower intakes of vitamin E, vitamin K, magnesium, and potassium. No significant difference in the prevalence of dietary supplement use was noted within HIV status and sex: HIV-positive (37%; SE 7) and negative men (38%; SE 1) and HIV-positive (53%; SE 13) and negative women (49%; SE 1) (data not shown).

Discussion

In this cross-sectional national survey, HIV-positive status in women but not men was associated with poor nutritional status including high BMI and waist circumference, lower mean dietary intakes of many key nutrients, and suboptimal concentrations of some biomarkers of nutritional status compared to HIV-negative adults. The mean BMI of HIV-infected women falls within the Grade II obese range, indicating substantially increased risk for cardiovascular disease, hypertension, and type 2 diabetes. Interestingly, the nutritional status of men with HIV did not differ substantially when compared to HIV-negative men; in fact, HIV positive men had a mean BMI that more closely approximated the normal range, with much lower waist circumference risk than any of the other groups. Indeed, men with HIV are very different than women with HIV in many ways and have a three-fold higher prevalence than women(12). The CDC estimates that the majority (83%) of new HIV infection in men is among men who have sex with men, whereas infection rates in women are not as related to sexual orientation (21). Data from multiple sources indicates HIV infection is higher in non-Hispanic blacks than other race/ethnic groups in both men and women (12, 21, 22).

Prior to the availability of ART, weight loss was an important diagnostic criterion for HIV and a distinguishing feature of AIDS (23, 24). However, in this post-ART analysis, the risk of overweight and obesity, specifically for women was observed. A study by Sharma et.al, suggested that HIV-positive women on ART treatment gain weight although ART use was associated with only modest change in BMI (25). A cohort study following HIV-infected adults in the U.S. and Canada also reported that HIV-positive white women had a higher BMI after 3 years of ART compared to their age-matched NHANES controls, while no such difference was observed for HIV-positive men or non-white women (26). Previous CDC reports indicate that approximately half of U.S. adults with HIV report use of ART (12). Given the dramatic differences in the BMI of men and women with HIV, the use of ART alone is unlikely responsible for the obesity observed in women with HIV. Future work should seek to understand the relationship of HIV and overweight and obesity in women, and if the association is driven by race/ethnicity or other factors. Previous studies have not observed an association of BMI and HIV status, but have documented higher waist circumference in HIV-infected adults when compared to HIV-negative adults (27).

Total protein concentrations were higher and albumin levels were lower in both men and women with HIV when compared within sex to non-infected adults, consistent with other studies (9, 28, 29). Lower serum albumin may be indicative of poor nutritional status or other health conditions and is an independent predictor of mortality in HIV-infected women (30). Among both men and women with HIV lower levels of serum folate were observed without difference in RBC folate when compared to HIV negative adults. While HIV infection is associated with anemia of chronic disease, we are unable to confirm the antecedents of low serum folate alone. Both HIV status (31-33) and ART (34-36) are individual predictors of vitamin D status and bone health. HIV-infected women with vitamin D deficiency have a higher risk of developing osteoporosis than HIV negative controls with vitamin D deficiency (37-42). Similar to other studies, this NHANES analysis also suggests that HIV-positive women are at higher risk of vitamin D inadequacy (<50 nmol/L), defined by the National Academy of Medicine and could be one of the contributing causes of high prevalence of osteopenia or osteoporosis among HIV-infected adults on ART (43).

To our knowledge this is the first study to characterize the nutrition status of people living with HIV in a nationally-representative sample of US adults. However, this national survey is not designed specifically for HIV and diseases with low population prevalence. Furthermore, a limited number of nutritional biomarkers were available across multiple years in NHANES. Limitations exist with self-reported dietary intake, including a well-known and characterized energy under-reporting bias (44). Due to the small number of participants that were

HIV-positive, it would not be possible to provide reliable estimates by stratifying on other factors beyond sex; however, given the strong association with infection and race/ethnicity future work should seek to address how race/ethnicity influence nutrition and infection. Similarly, the very small sample sizes, particularly among women, indicate that much more data are needed to understand the nutritional needs associated with HIV infection in the U.S. Our results should be considered with the caveats in mind. The findings of this report should be a call to action that much more data are needed on the nutritional aspects of living with HIV in America.

Author's Contributions: SVT designed the project and performed the preliminary data analysis. SVT, SJ, AC, and RLB performed the literature search, drafted sections of the manuscript, and aided in data interpretation. SJ and AC prepared the data tables and confirmed the data presented within this paper that was originally prepared by SVT. All authors have read and approved the final manuscript. The authors wish to thank Victor Fulgoni (Nutrition Impact LLC) and Jaime Gahche (NIH/Office of Dietary Supplements) who provided unpaid consulting on the NHANES methodology and provided guidance to the data analysis.

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Table 1. Baseline age and population distribution of demographic details of U.S. adults aged 19-49 years by HIV status and sex[1,2]

	HIV+ adults : Group A				HIV- adults : Group B				
	All n=87	Men n=67	Women n=20	p-value	All n=15,868	Men n=7,907	Women n=7,961	p- value	p-value A vs B
Age in years, mean (SE)	37.7 (1.0)	36.8 (1.3)	40.7 (1.6)	0.05	34.3 (0.15)	34.1 (0.2)	34.7 (0.2)	0.001	0.001
Sex (%)									
Men	76.6 (4.5)				49.2 (0.4)				<0.001
Women	23.4 (4.5)				50.8 (0.4)				
Education (%)									
Lower than High School	25.2 (5.5)	23.4 (6.0)	31.0 (10.8)	0.525	16.4 (0.6)	17.5 (0.7)	15.2 (0.6)	<0.001	0.113
High School or more	74.8 (5.5)	76.6 (6.0)	69.0 (10.8)		83.6 (0.6)	82.5 (0.7)	84.8 (0.6)		
Race/Ethnicity (%)[3]									
Non-Hispanic white	26.3 (6.8)	32.2 (8.1)	7.1 (6.7)	0.013	63.5 (1.5)	63.9 (1.5)	63.3 (1.6)	<0.001	<0.001
Non-Hispanic black	55.3 (6.7)	47.1 (7.2)	82.1 (11.1)		12.0 (0.8)	10.8 (0.7)	13.1 (0.9)		
Hispanic and Mexican	15.9 (3.6)	20.7 (5.0)	-		17.2 (1.1)	18 (1.1)	16.4 (1.1)		
Poverty Income Ratio (%)									
< 130%	40.3 (6.7)	37.0 (7.3)	51.0 (13.9)	0.023	24.8 (0.8)	22.7 (0.8)	26.9 (0.9)	<0.001	0.003
130-350%	40.0 (6.3)	37.3 (6.7)	49.0 (13.8)		35.2 (0.8)	35.8 (0.9)	34.7 (0.8)		
≥ 350%	19.7 (6.5)	25.7 (7.8)	-		39.9 (1.0)	41.5 (1.0)	38.4 (1.2)		
Marital Status (%)									
Married/living together	44.1 (6.4)	39.4 (7.9)	58.6 (10.4)	0.183	68.2 (0.8)	69.2 (1.0)	67.1 (0.8)	<0.001	<0.001
Widowed/divorced/separated	16.4 (4.2)	16.0 (4.4)	17.6 (9.2)		14.1 (0.4)	12.5 (0.5)	15.8 (0.5)		
Never married	39.5 (6.0)	44.6 (7.2)	23.8 (8.5)		17.7 (0.9)	18.3 (1.1)	17.1 (0.9)		

[1] Data from National Health and Nutrition Examination Survey, 2003-2014. Unless otherwise noted, estimates are percentages (SE). *Proc descript* was used for mean age comparison and *proc crosstab* procedure was used for comparing all categorical percentages by sex and by HIV status

[2] Not showing "other" race/ethnic group

Table 2. Biomarkers of nutritional status and biochemistry profile in U.S. adults aged 19-49 years by HIV status and sex[1]

	HIV+ adults		HIV- adults				
	Mean (SE)		Mean (SE)		p-value		
	A Men n=65	B Women n=20	C Men n= 7,838	D Women n=7,869	A vs C	B vs D	A vs B
BMI (kg/m^2)	26.2 (0.7)	34.3 (2.3)	28.3 (0.1)	28.3 (0.1)	0.0042	0.0091	0.0009
% Overweight Obese[2]	50.5 (6.1)	83.5 (10.7)	68.9 (0.8)	59.4 (0.9)	0.0039	0.0273	0.0090
Waist Circumference (cm)	93.7 (2.2)	107.4 (5.4)	98.2 (0.3)	93.0 (0.3)	0.0463	0.0089	0.0220
% At risk[3]	15.2 (5.2)	81.6 (11.8)	35.3 (0.8)	55.0 (0.9)	0.0004	0.0280	<0.0001
Total Protein (g/L)	76.0 (1.3)	79.3 (1.5)	72.3 (0.1)	71.2 (0.1)	0.0042	<0.0001	0.0864
Albumin (g/L)	41.7 (0.6)	38.6 (0.8)	44.6 (0.1)	42.0 (0.1)	< 0.0001	<0.0001	0.0023
Cholesterol (mmol/L)	4.7 (0.2)	4.7 (0.2)	5.0 (0.0)	4.9 (0.0)	0.0412	0.3221	0.8164
Triglycerides (mmol/L)	2.1 (0.2)	2.1 (0.4)	1.9 (0.0)	1.4 (0.0)	0.5248	0.0526	0.8322
Serum Glucose (mmol/L)	5.1 (0.1)	7.6 (2.4)	5.3 (0.0)	5.1 (0.0)	0.2439	0.2921	0.2968
Vitamin D (nmol/L)	57.8 (4.3)	43.7 (7.1)	62.7 (0.8)	64.6 (0.8)	0.2821	0.0044	0.1107
RBC Folate (nmol/L)	765.9 (62.0)	914.9 (210.9)	852.8 (10.3)	897.7 (10.2)	0.1843	0.9350	0.4996
Serum Folate (nmol/L)	26.7 (2.1)	24.9 (3.4)	31.6 (0.5)	36.3 (0.5)	0.0261	0.0015	0.6494

[1]Data from National Health and Nutrition Examination Survey 2003-2014 were combined. The sample size shown is for participation in the Mobile Examination Center. For vitamin D, the data was available only from 2003 to 2010 (n=10,538). For RBC folate and serum folate, data was available only from 2003-2012 (n=13,600).

[2] Overweight (BMI >25 kg/m^2) and obese (BMI >30 kg/m^2) are combined for this analysis.

[3] Waist circumference: > 88 cm for women, and > 102 cm for men.

Table 3. Mean (SE) energy and nutrient intakes of U.S. adults aged 19-49 years by sex and HIV status[1]

	HIV+ adults Mean (SE)		HIV- adults Mean (SE)		p-value	
	A Men n=56	B Women n=18	C Men n=6,410	D Women n=6,715	A vs C	B vs D
Energy (kcal)	2820.4 (158.3)	2002.2 (213.9)	2643.3 (18.6)	1859.5 (10.1)	0.2621	0.5049
Macronutrients						
Carbohydrate (g)	341.1 (29.9)	251.6 (32.3)	315.7 (2.3)	231.1 (1.4)	0.3927	0.5255
Protein (g)	104.9 (6.0)	83.5 (6.1)	104.4 (0.7)	71.3 (0.5)	0.9305	0.0469
Fat (g)	105.5 (5.7)	67.9 (8.6)	98.7 (0.9)	70.1 (0.6)	0.2407	0.8044
Fiber (g)	17.9 (1.8)	9.2 (1.5)	18.7 (0.2)	14.7 (0.2)	0.6816	0.0004
Micronutrients						
Vitamin A, RAE (µg)	689.5 (83.1)	439.9 (77.0)	671.7 (9.4)	568.2 (10.1)	0.8296	0.0988
Thiamin (mg)	2.0 (0.2)	1.4 (0.1)	2.0 (0.0)	1.4 (0.0)	0.9131	0.9369
Riboflavin (mg)	2.4 (0.2)	1.7 (0.2)	2.6 (0.0)	1.9 (0.0)	0.3897	0.1438
Niacin (mg)	29.6 (1.7)	25.7 (1.5)	32.7 (0.3)	21.8 (0.1)	0.0700	0.0112
Folate (µg)	466.4 (49.7)	347.8 (28.4)	488.5 (4.8)	362.0 (4.2)	0.6514	0.6212
Vitamin B6 (mg)	2.3 (0.1)	1.8 (0.2)	2.6 (0.0)	1.8 (0.0)	0.0410	0.7467
Vitamin B12 (µg)	5.6 (0.6)	6.3 (1.3)	6.6 (0.1)	4.4 (0.1)	0.0853	0.1476
Vitamin C (mg)	89.3 (12.2)	74.7 (18.3)	92.4 (1.7)	77.4 (1.5)	0.8026	0.8805
Vitamin E (mg)	8.9 (0.8)	4.6 (0.6)	9.1 (0.1)	7.2 (0.1)	0.7101	0.0001
Vitamin K (µg)	102.4 (15.5)	48.5 (9.2)	106.0 (2.4)	101.2 (2.4)	0.8114	<0.0001
Calcium (mg)	1171.2 (92.6)	711.8 (78.6)	1140.6 (11.5)	863.3 (8.7)	0.7439	0.0582
Iron (mg)	18.8 (1.6)	14.6 (1.3)	18.6 (0.2)	13.5 (0.1)	0.9394	0.3743
Magnesium (mg)	337.2 (23.9)	194.7 (22.1)	345.2 (3.0)	261.1 (2.7)	0.7402	0.0036
Phosphorus (mg)	1714.5 (106.4)	1149.4 (104.3)	1678.2 (13.1)	1191.1 (8.6)	0.7356	0.6884
Sodium (mg)	4818.7 (262.9)	2927.3 (276.5)	4343.8 (31.9)	3070.5 (18.2)	0.0767	0.6060
Potassium (mg)	3069.5 (174.2)	1877.1 (157.3)	3085.2 (23.7)	2319.8 (18.5)	0.9291	0.0058
Zinc (mg)	14.6 (1.0)	10.9 (1.1)	14.8 (0.2)	10.1 (0.1)	0.9044	0.4552

[1]Dietary data from National Health and Nutrition Examination Survey, 2003-2014 were combined to estimate mean total nutrient intake. RAE, Retinol Activity Equivalents.