Protein intake trends and conformity with the Dietary Reference Intakes in the United States: analysis of the National Health and Nutrition Examination Survey, 2001–2014

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ABSTRACT

Background: Systematic analysis of dietary protein intake may identify demographic groups within the American population that are not meeting the Dietary Reference Intakes (DRIs).

Objective: This cross-sectional study analyzed protein intake trends (2001–2014) and evaluated recent conformity to the DRIs (2011–2014) according to age, sex, and race or ethnicity in the US population.

Design: Protein intakes and trends during 2-y cycles of NHANES 2001–2014 (n = 57,980; ≥2 y old) were calculated as absolute (grams per day) and relative [grams per kilogram of ideal body weight (IBW) per day] intakes and as a percentage of total energy. Sex and race or ethnicity [Asian, Hispanic, non-Hispanic black (NHB), and non-Hispanic white (NHW)] differences were determined for protein intake and percentage of the population below the Estimated Average Requirement (EAR) and Recommended Dietary Allowance, and above and below the Acceptable Macronutrient Distribution Range (AMDR).

Results: Usual protein intakes (mean ± SE) averaged from 55.3 ± 0.9 (children aged 2–3 y) to 88.2 ± 1.1 g/d (adults aged 19–30 y). Protein comprised 14–16% of total energy intakes. Relative protein intakes averaged from 1.10 ± 0.01 (adults aged ≥71 y) to 3.63 ± 0.07 g · kg IBW^{-1} · d^{-1} (children aged 2–3 y), and were above the EAR in all demographic groups. Asian and Hispanic populations aged >19 y consumed more relative protein (1.32 ± 0.02 and 1.32 ± 0.02 g · kg IBW^{-1} · d^{-1}, respectively) than did NHB and NHW (1.18 ± 0.01 g · kg IBW^{-1} · d^{-1}). Relative protein intakes did not differ by race or ethnicity in the 2–18 y population. Adolescent (aged 14–18 y) females and older (aged ≥71 y) NHB men had the largest population percentages below the EAR (11% and 13%, respectively); <1% of any demographic group had intakes above the AMDR.

Conclusions: The majority of the US population exceeds minimum recommendations for protein intake. Protein intake remains well below the upper end of the AMDR, indicating that protein intake, as a percentage of energy intake, is not excessive in the American diet. This trial was registered at www.isrctn.com as ISRCTN76534484. *Am J Clin Nutr* 2018;108:405–413.

Keywords: NHANES, Estimated Average Requirement, Recommended Dietary Allowance, Acceptable Macronutrient Distribution Range, race and ethnicity

INTRODUCTION

Dietary protein is required for the maintenance of all body processes, providing the structural and functional foundation to support life (1). In humans, 20 distinct amino acids function as substrates for protein synthesis (1). Nine of these amino acids are essential amino acids, which cannot be synthesized by the body and must be acquired from the diet (1). The Dietary Reference Intakes (DRIs) for protein, which include the Estimated Average Requirement (EAR; children aged 1–3 y: 0.87, children aged 4–13 y: 0.76, boys aged 14–18 y: 0.73, girls aged 14–18 y: 0.71, adults aged ≥19 y: 0.66 g protein · kg^{-1} · d^{-1}) and Recommended Dietary Allowance (RDA; children aged 1–3 y: 1.05, children

Supported by the US Army Medical Research and Materiel Command and the Department of Defense Center Alliance for Nutrition and Dietary Supplements Research.

Supplemental Figure 1 is available from the "Supplementary data" link in the online posting of the article and from the same link in the online table of contents at https://academic.oup.com/ajcn/.

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Abbreviations used: AMDR, Acceptable Macronutrient Distribution Range; DRI, Dietary Reference Intake; EAR, Estimated Average Requirement; IBW, ideal body weight; NHB, non-Hispanic black; NHW, non-Hispanic white; RDA, Recommended Dietary Allowance.

Received January 18, 2018. Accepted for publication April 4, 2018.

First published online June 21, 2018; doi: https://doi.org/10.1093/ajcn/nqy088.

aged 4–13 y: 0.95, boys and girls aged 14–18 y: 0.85, adults aged ≥19 y, 0.80 g protein · kg^{-1} · d^{-1}), quantify specific nutrient intake requirements that are the basis for assessing and planning adequate diets for individuals and populations (1). An inability to meet the EAR or RDA for any one essential amino acid can be detrimental, leading to a negative nitrogen balance and a loss of functional body proteins (2–5). This is particularly important in populations that are susceptible to loss of muscle mass and physical function (6–9). An analysis of 2003–2004 NHANES data showed that 7–9% of older (aged ≥51 y) females and 8% of young (aged 9–18 y) females were not meeting the EAR for protein (10). Characterization of protein intake patterns provides information to inform both policy guidelines and nutrition counseling for various demographics of the US population.

The apparent popularity of diets that are higher in protein has increased over the past 2 decades. There has been a change from the idea that higher-protein diets (for adults, >0.8 g protein · kg^{-1} · d^{-1} and ≤35% of total energy) only benefit athletes to an understanding of the broader health advantages. In 2015, the Food and Health Survey reported 89% of Americans agreed with the statement "it is important to get enough protein in the diet," 81% with "protein can help maintain muscle during aging," and 65% with "high protein diets can help with weight loss" (11). Protein has been shown to promote weight loss and maintenance while preserving muscle mass (12–14). Increased protein intake is associated with lower body weight, BMI, and waist circumference and higher HDL cholesterol levels (15). In the United States, market trends indicate that protein-containing food product sales have grown from ∼$600 million in 2008 to ∼$1.1 billion in 2013 and are projected to reach ∼$1.6 billion in 2018 (16). Whether widespread awareness regarding the advantages of dietary protein and increased availability of protein-containing food products have influenced dietary protein intake trends in the US population is unknown.

The current study, a systematic update to our previous work (10), characterizes protein intake trends over the past 14 y (2001–2014) and assesses recent (2011–2014) conformity with protein-specific DRIs according to age, sex, race, and ethnicity in the US population. Importantly, this study evaluates protein intake trends and DRI conformity parameters by race and ethnicity and in Americans aged ≥80 y, allowing identification of demographic groups that may be particularly vulnerable to inadequate protein intake.

METHODS

NHANES is a large ongoing dietary survey of a nationally representative sample of the non-institutionalized US population. The data are collected and released by the National Center for Health Statistics, part of the Centers for Disease Control and Prevention, every 2 y. The Research Ethics Review Board at the National Center for Health Statistics approved the survey protocol and all participants or proxies provided written informed consent. Detailed descriptions of the survey design and the data collection procedures are reported elsewhere (17). The current trial was registered with the ISRCTN registry (www.isrctn.com) as ISRCTN76534484.

Data from NHANES 2001–2014 were used to determine mean protein intakes during the entire period (2001–2014) and for each 2-y cycle (2001–2002, 2003–2004, 2005–2006, 2007–2008, 2009–2010, 2011–2012, 2013–2014). The study sample included individuals (n = 57,980; aged ≥2 y) with complete and reliable dietary records using the USDA automated multiple-pass method (**Supplemental Figure 1**). Pregnant or lactating females (n = 1442) and individuals consuming no calories (n = 34) were excluded. Individuals were grouped by DRI-specific age and sex categories (1). Overall and cycle-specific protein intake means were determined using data from the first 24-h recall. Cycle trends were evaluated using regression analyses with cycle as the independent variable and regression coefficient (β) representing change over time.

Data from NHANES 2011–2014 (n = 15,829; aged ≥2 y) were used to determine current protein intake by age (2–18, ≥19, ≥51, and ≥71 y), sex, and race/ethnicity [Asian, non-Hispanic black (NHB), Hispanic, and non-Hispanic white (NHW)]. Usual intake means were derived from 2 nonconsecutive 24-h recalls, one in person and the other via telephone, using the National Cancer Institute method (18). Usual intake analyses were conducted separately for each ethnicity group and stratified by age and sex. The covariates used were weekday/weekend intake day and DRI age groups (with 2 additional groups: ages 71–79 and ≥80 y). Ethnicity was added as a covariate for the ethnicity = all group, and sex was added as a covariate in the analysis of children. Differences in usual protein intake between sex and race or ethnicity groups were evaluated using a z statistic, with $P \leq 0.01$ considered significant. Data from NHANES 2011–2014 were also used to determine the percentage of the population consuming less than the EAR, RDA, and Acceptable Macronutrient Distribution Range (AMDR) and more than the AMDR for age, sex, and race or ethnicity group. Individuals with missing race or ethnicity data or marking "Other Race" on the survey (n = 652) were omitted from the race or ethnicity-specific analyses.

Protein intake is presented 3 ways: *1*) grams of protein per day, *2*) grams of protein per kilogram of ideal body weight (IBW), and *3*) percentage of energy from protein. For grams of protein per kilogram of IBW calculations, body weights were adjusted to the nearest IBW. For example, for adults who were overweight or obese, body weights were adjusted to a BMI (kg/m^2) of 24.9, and for adults who were underweight, body weights were adjusted to a BMI of 18.5. For children whose weights were less than the 5th percentile for BMI for age, body weight was adjusted to 5% of BMI for age. For children whose weights were greater than the 85th percentile for BMI for age, body weight was adjusted to 84.9%. IBW was used, rather than actual body weight, to align with previous work (10).

Data were analyzed using SAS version 9.2 (SAS Institute, Cary, NC) and SUDAAN release 11.0 (Research Triangle Institute, Research Triangle Park, NC). Appropriate sample weights were used to adjust for the complex sample design of NHANES. Data are presented as mean ± SE, unless stated otherwise.

RESULTS

Absolute protein intake was lowest in children aged 2–3 y (55.3 ± 0.9 g/d) and highest in adults aged 19–30 y (88.2 ± 1.1 g/d; **Figure 1**). Relative protein intake was lowest in adults aged ≥71 y (1.10 ± 0.01 g · kg IBW^{-1} · d^{-1}) and highest in children aged 2–3 y (3.63 ± 0.07 g · kg IBW^{-1} · d^{-1}). Protein intake, as a percentage of total energy intake, ranged from 14% to 16% across all age groups. The only population to have a significant,

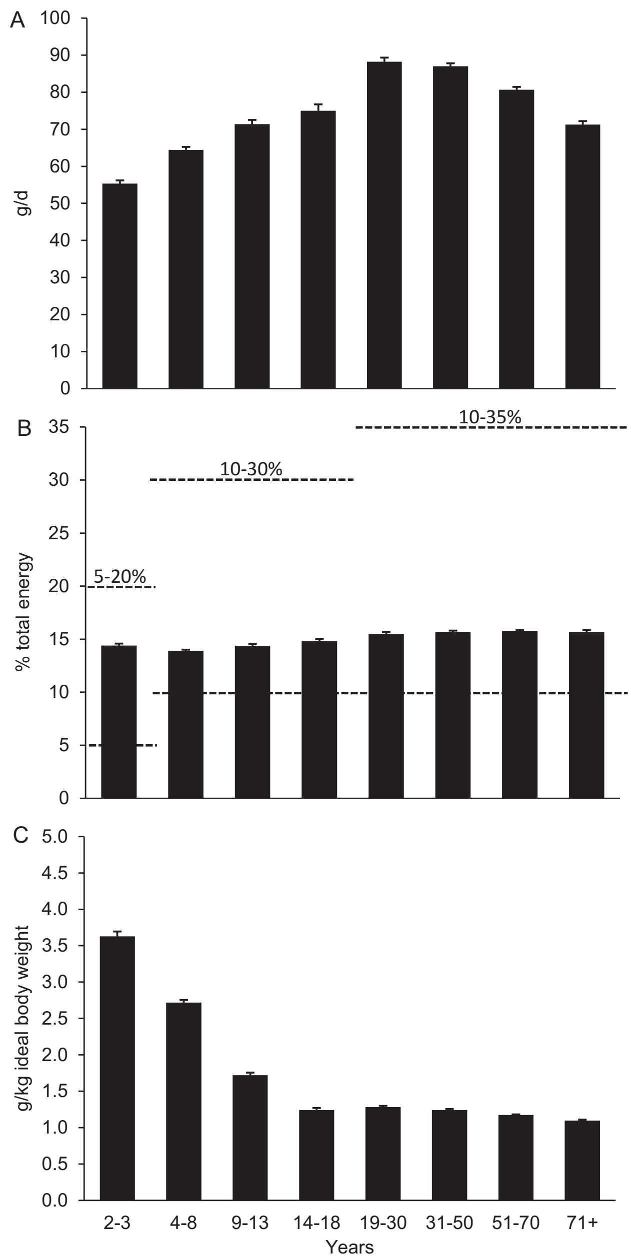

FIGURE 1 Usual protein intake (mean ± SE) by age in the US population (NHANES, 2011–2014; $n = 15{,}829$) is presented as absolute amounts (A), percentage of total energy intake (B), and relative to ideal body weight (C). Dotted lines represent the upper and lower bounds of the Acceptable Macronutrient Distribution Range for protein by age group.

albeit small, increase in all estimates of protein intake from 2001 to 2014 were men aged ≥71 y (1.15 ± 0.35 g · d^{-1} · cycle^{-1}, 0.02 ± 0.00 g · kg IBW^{-1} · d^{-1} · cycle^{-1}, and 0.14% ± 0.05% total energy/cycle; **Table 1**).

When males and females from the NHANES 2011–2014 cohort were combined for race and ethnicity analysis, Asian and Hispanic individuals aged 2–18 y consumed significantly more protein (72.0 ± 2.7 and 71.6 ± 1.4 g/d, respectively) than NHB individuals (64.6 ± 0.7 g/d) of the same age range (**Table 2**). In terms of protein intake as a percentage of total energy, Hispanic individuals aged 2–18 y consumed more protein (14.8% ± 0.1%) than did NHB and NHW individuals (13.9% ± 0.1% and 14.2% ± 0.2%, respectively), whereas Asian individuals consumed significantly more protein (15.9% ± 0.3%) than all 3 groups. However, there were no ethnicity or race differences for the population aged 2–18 y when protein intake was expressed relative to IBW.

In the sex-combined analysis for individuals aged ≥19 y, Hispanic individuals consumed significantly more protein (89.5 ± 1.3 g/d) than did Asian, NHB, and NHW individuals during 2011–2014 (81.8 ± 1.5, 81.5 ± 1.0, and 82.7 ± 0.6 g/d, respectively; Table 2). Protein intake as a percentage of total energy intake and relative to IBW were greater for both the Asian (17.2% ± 0.2% and 1.32 ± 0.02 g · kg IBW^{-1} · d^{-1}, respectively) and Hispanic (16.5% ± 0.1% and 1.35 ± 0.02 g · kg IBW^{-1} · d^{-1}, respectively) populations compared with the NHB (15.2% ± 0.1% and 1.18 ± 0.01 g · kg IBW^{-1} · d^{-1}, respectively) and NHW (15.5% ± 0.2% and 1.18 ± 0.01 g · kg IBW^{-1} · d^{-1}, respectively) populations.

In the ethnicity and race combined analysis, no children aged 2–3 or 4–8 y fell below the EAR or RDA for protein (**Table 3**). A greater percentage of females aged 19–30, 31–50, and 51–70 y fell below the EAR for protein (4.10–5.34%) than that of males of the same age range (0.59–1.92%). Similarly, a greater percentage of females aged 9–13, 14–18, 19–30, 31–50, and 51–70 y had protein intakes below the RDA (6.92–23.36%) compared with males of the same age range (2.31–11.26%). Furthermore, <5% of any population had protein intakes below the AMDR, and <1% of any population had protein intakes above the AMDR (Tables 3 and **4**).

When males and females were combined for race and ethnicity analysis, a smaller percentage of the Asian and Hispanic populations aged 2–18 y fell below the EAR (0.52% ± 0.54% and 1.63% ± 0.53%, respectively) and RDA (2.02% ± 1.15% and 4.19% ± 0.90%, respectively) for protein than in the NHB population (EAR: 5.20% ± 0.86%, RDA: 10.47% ± 1.14%; Table 4, **Figure 2**). Furthermore, a smaller percentage of the Asian population aged 2–18 y fell below the RDA for protein than in the NHW population (7.08% ± 1.58%). In individuals aged ≥19 y, a smaller percentage of the Asian and Hispanic populations fell below the EAR (1.30% ± 0.44% and 1.71% ± 0.53%, respectively) for protein than in the NHB population (4.69% ± 0.83%). In addition, a smaller percentage of the Asian population aged ≥19 y fell below the EAR for protein than in the NHW population (3.43% ± 0.51%). In individuals aged ≥19 y, a smaller percentage of the Asian and Hispanic populations fell below the RDA (5.10% ± 1.01% and 6.03% ± 1.15%, respectively) for protein than in the NHB and NHW populations (13.43% ± 1.35% and 11.07% ± 0.91%, respectively).

DISCUSSION

The current study characterized protein intake trends in the US population (2001–2014) and evaluated recent conformity with protein-specific DRIs (2011–2014). This report used data from more individuals, to our knowledge, than any previous study to quantify the percentage of the population not meeting DRI standards for protein by ethnicity and race, and in older adults aged ≥80 y. The current findings indicate: *1*) protein intake in the United States has been generally stable over the past 14 y, with the only consistent increase in protein intake during that time

TABLE 1
Trends in protein intake by age and sex from NHANES, 2001–2014[1]

Protein intake by sex	Age, y	n	2001–2014	2001–2002	2003–2004	2005–2006	2007–2008	2009–2010	2011–2012	2013–2014	β	SE	P
Protein, g/d													
Combined	2–3	3208	53.3 ± 0.6	52.9 ± 1.2	55.9 ± 1.7	51.9 ± 1.6	52.4 ± 2.2	54.1 ± 1.1	53.2 ± 1.1	52.7 ± 1.4	−0.12	0.25	0.6405
	4–8	6311	61.6 ± 0.5	63.5 ± 0.9	65.7 ± 1.6	60.3 ± 1.4	57.8 ± 0.9	61.1 ± 1.1	63.2 ± 0.7	59.7 ± 1.6	−0.54	0.25	0.0302
Females	9–13	3333	65.0 ± 0.9	64.2 ± 1.8	67.2 ± 2.1	66.0 ± 2.6	65.9 ± 2.1	63.6 ± 1.9	62.6 ± 3.7	66.1 ± 2.1	−0.24	0.46	0.6115
	14–18	3430	63.9 ± 0.8	63.7 ± 1.6	67.0 ± 1.6	64.9 ± 2.0	63.1 ± 2.2	64.2 ± 2.2	66.4 ± 2.5	58.7 ± 2.2	−0.65	0.38	0.0859
	19– 30	3429	70.3 ± 0.8	71.8 ± 1.8	72.3 ± 2.3	69.6 ± 2.1	69.6 ± 1.7	67.7 ± 1.9	71.1 ± 1.9	70.3 ± 2.1	−0.31	0.38	0.4212
	31– 50	5724	70.8 ± 0.6	69.5 ± 1.6	68.9 ± 1.7	74.7 ± 1.7	69.8 ± 1.5	70.3 ± 1.3	69.6 ± 1.6	72.9 ± 1.5	0.25	0.30	0.3981
	51–70	5287	66.8 ± 0.7	64.3 ± 1.1	66.6 ± 2.8	67.3 ± 2.0	65.1 ± 1.8	67.6 ± 1.6	66.6 ± 1.3	69.0 ± 1.1	0.50	0.29	0.0902
	≥71	2821	58.1 ± 0.6	56.3 ± 1.6	58.8 ± 1.1	57.0 ± 1.8	56.6 ± 1.2	59.8 ± 1.7	59.1 ± 1.4	59.1 ± 1.8	0.41	0.30	0.1635
	≥80	1247	56.2 ± 0.8	54.0 ± 1.8	55.8 ± 2.3	53.2 ± 1.4	55.1 ± 1.7	57.1 ± 2.2	57.8 ± 2.3	60.0 ± 2.2	0.93	0.39	0.0203
Males	9–13	3274	78.6 ± 1.1	80.2 ± 3.6	82.2 ± 2.7	75.0 ± 2.9	81.1 ± 3.7	74.2 ± 1.7	78.8 ± 1.5	78.3 ± 2.5	−0.49	0.53	0.3629
	14–18	3664	97.3 ± 1.5	94.5 ± 3.7	97.6 ± 4.3	105.4 ± 3.2	92.1 ± 2.1	98.5 ± 4.1	90.5 ± 5.3	100.8 ± 4.2	−0.05	0.78	0.9477
	19–30	3869	106.3 ± 1.2	104.4 ± 4.1	108.8 ± 2.5	108.2 ± 3.3	104.1 ± 3.2	102.7 ± 3.2	105.9 ± 2.4	109.5 ± 3.2	0.16	0.62	0.7944
	31–50	5675	105.6 ± 0.8	103.1 ± 2.2	105.9 ± 2.1	111.1 ± 2.1	104.1 ± 2.5	106.5 ± 2.4	107.4 ± 1.9	101.2 ± 1.7	−0.22	0.38	0.5603
	51–70	5190	91.5 ± 0.8	88.4 ± 2.3	88.4 ± 2.2	93.1 ± 2.4	91.6 ± 2.5	95.1 ± 1.8	90.9 ± 2.5	92.0 ± 1.3	0.58	0.38	0.1316
	≥71	2765	75.8 ± 0.8	74.0 ± 1.4	72.3 ± 2.7	76.7 ± 1.6	72.6 ± 2.7	73.2 ± 1.9	80.7 ± 1.7	79.8 ± 1.8	1.15	0.35	0.0015
	≥80	1123	71.2 ± 1.1	69.4 ± 2.0	67.9 ± 3.0	71.7 ± 1.8	69.7 ± 3.2	67.2 ± 2.5	76.9 ± 2.6	73.8 ± 3.7	1.02	0.57	0.0755
Protein, % calories													
Combined	2–3	3208	14.3 ± 0.1	13.9 ± 0.2	14.1 ± 0.3	14.2 ± 0.3	14.3 ± 0.3	14.6 ± 0.3	14.2 ± 0.2	14.7 ± 0.3	0.10	0.05	0.0336
	4–8	6311	13.6 ± 0.1	13.5 ± 0.2	13.4 ± 0.2	13.3 ± 0.2	13.4 ± 0.2	14.1 ± 0.2	13.5 ± 0.1	13.8 ± 0.3	0.06	0.04	0.1070
Females	9–13	3333	13.9 ± 0.1	13.4 ± 0.3	13.5 ± 0.4	13.8 ± 0.2	14.0 ± 0.3	13.7 ± 0.4	14.0 ± 0.5	14.8 ± 0.4	0.18	0.08	0.0226
	14–18	3430	13.8 ± 0.1	13.3 ± 0.3	13.3 ± 0.2	13.6 ± 0.3	13.7 ± 0.4	14.2 ± 0.3	13.9 ± 0.4	14.4 ± 0.4	0.18	0.06	0.0058
	19–30	3429	14.7 ± 0.1	14.0 ± 0.4	14.3 ± 0.4	14.8 ± 0.3	15.3 ± 0.4	14.7 ± 0.2	14.6 ± 0.3	15.1 ± 0.5	0.13	0.07	0.0834
	31–50	5724	15.3 ± 0.1	14.9 ± 0.3	14.5 ± 0.2	16.1 ± 0.3	15.0 ± 0.2	15.7 ± 0.1	15.0 ± 0.4	15.5 ± 0.2	0.08	0.05	0.0998
	51–70	5287	15.7 ± 0.1	15.2 ± 0.2	15.6 ± 0.3	16.3 ± 0.2	15.6 ± 0.2	15.8 ± 0.3	15.3 ± 0.2	16.1 ± 0.3	0.05	0.05	0.3183
	≥71	2821	15.3 ± 0.1	15.0 ± 0.3	15.3 ± 0.2	15.4 ± 0.3	15.4 ± 0.2	15.7 ± 0.3	15.4 ± 0.4	15.1 ± 0.3	0.02	0.06	0.7136
	≥80	1247	15.3 ± 0.1	14.8 ± 0.4	15.1 ± 0.3	15.4 ± 0.4	15.1 ± 0.2	15.6 ± 0.4	15.2 ± 0.3	15.4 ± 0.4	0.07	0.08	0.3429
Males	9–13	3274	14.2 ± 0.1	13.9 ± 0.3	13.9 ± 0.4	13.8 ± 0.3	14.5 ± 0.2	14.5 ± 0.3	14.3 ± 0.3	14.7 ± 0.3	0.13	0.06	0.0282
	14–18	3664	14.8 ± 0.1	13.9 ± 0.4	14.2 ± 0.2	14.6 ± 0.3	15.3 ± 0.3	14.9 ± 0.3	14.9 ± 0.5	16.0 ± 0.4	0.30	0.07	0.0001
	19–30	3869	15.4 ± 0.1	14.3 ± 0.4	15.0 ± 0.3	15.3 ± 0.3	15.4 ± 0.2	15.6 ± 0.3	15.5 ± 0.2	16.6 ± 0.5	0.29	0.08	0.0003
	31–50	5675	15.7 ± 0.1	15.0 ± 0.3	15.0 ± 0.2	15.8 ± 0.2	15.7 ± 0.2	16.0 ± 0.3	15.8 ± 0.2	16.2 ± 0.2	0.20	0.05	<0.0001
	51–70	5190	15.8 ± 0.1	15.3 ± 0.3	16.1 ± 0.3	15.6 ± 0.2	16.0 ± 0.2	16.2 ± 0.3	15.5 ± 0.3	15.8 ± 0.4	0.03	0.06	0.5709
	≥71	2765	15.9 ± 0.1	15.4 ± 0.2	15.6 ± 0.3	15.7 ± 0.3	15.9 ± 0.3	15.7 ± 0.2	16.3 ± 0.4	16.3 ± 0.3	0.14	0.05	0.0089
	≥80	1123	15.5 ± 0.2	15.7 ± 0.3	15.6 ± 0.6	15.2 ± 0.3	15.6 ± 0.4	15.4 ± 0.3	15.3 ± 0.6	15.8 ± 0.5	0.00	0.09	0.9632
Protein, g · kg IBW^{-1} · d^{-1}													
Combined	2–3	2984	3.65 ± 0.04	3.55 ± 0.08	3.87 ± 0.14	3.61 ± 0.11	3.57 ± 0.16	3.73 ± 0.10	3.62 ± 0.08	3.62 ± 0.09	−0.01	0.02	0.7632
	4–8	6244	2.70 ± 0.02	2.75 ± 0.06	2.89 ± 0.07	2.66 ± 0.06	2.61 ± 0.06	2.71 ± 0.05	2.75 ± 0.05	2.56 ± 0.07	−0.03	0.01	0.0242
Females	9–13	3310	1.56 ± 0.02	1.53 ± 0.04	1.60 ± 0.06	1.56 ± 0.06	1.64 ± 0.06	1.51 ± 0.04	1.50 ± 0.09	1.61 ± 0.05	0.00	0.01	0.9152
	14–18	3369	1.12 ± 0.02	1.13 ± 0.03	1.20 ± 0.03	1.14 ± 0.04	1.11 ± 0.05	1.10 ± 0.04	1.19 ± 0.04	1.01 ± 0.04	−0.02	0.01	0.0231
	19–30	3386	1.15 ± 0.01	1.18 ± 0.03	1.19 ± 0.05	1.15 ± 0.04	1.13 ± 0.02	1.10 ± 0.04	1.14 ± 0.03	1.15 ± 0.04	−0.01	0.01	0.2508
	31–50	5664	1.12 ± 0.01	1.11 ± 0.02	1.09 ± 0.03	1.19 ± 0.03	1.10 ± 0.03	1.12 ± 0.02	1.10 ± 0.03	1.15 ± 0.02	0.00	0.00	0.6680
	51–70	5212	1.06 ± 0.01	1.02 ± 0.01	1.05 ± 0.04	1.06 ± 0.03	1.03 ± 0.03	1.08 ± 0.03	1.07 ± 0.02	1.11 ± 0.02	0.01	0.00	0.0099
	≥71	2687	0.98 ± 0.01	0.98 ± 0.02	0.98 ± 0.02	0.96 ± 0.03	0.95 ± 0.02	1.01 ± 0.03	1.00 ± 0.02	1.00 ± 0.03	0.01	0.01	0.2549
	≥80	1170	0.99 ± 0.01	0.98 ± 0.04	0.97 ± 0.04	0.92 ± 0.03	0.96 ± 0.04	1.00 ± 0.04	1.02 ± 0.03	1.04 ± 0.04	0.01	0.01	0.0585
Males	9–13	3253	1.93 ± 0.02	2.03 ± 0.08	2.03 ± 0.06	1.86 ± 0.05	1.95 ± 0.09	1.81 ± 0.06	1.88 ± 0.04	1.95 ± 0.06	−0.02	0.01	0.1072
	14–18	3632	1.47 ± 0.02	1.42 ± 0.05	1.47 ± 0.06	1.59 ± 0.06	1.41 ± 0.03	1.52 ± 0.06	1.36 ± 0.08	1.51 ± 0.05	0.00	0.01	0.9410
	19–30	3830	1.45 ± 0.02	1.41 ± 0.06	1.47 ± 0.04	1.47 ± 0.05	1.43 ± 0.04	1.40 ± 0.05	1.44 ± 0.03	1.50 ± 0.04	0.01	0.01	0.5086
	31–50	5620	1.39 ± 0.01	1.36 ± 0.03	1.40 ± 0.03	1.45 ± 0.03	1.37 ± 0.03	1.40 ± 0.03	1.42 ± 0.03	1.33 ± 0.02	0.00	0.01	0.6849
	51–70	5118	1.21 ± 0.01	1.18 ± 0.03	1.16 ± 0.03	1.24 ± 0.04	1.21 ± 0.03	1.26 ± 0.03	1.21 ± 0.03	1.23 ± 0.02	0.01	0.01	0.0844
	≥71	2626	1.06 ± 0.01	1.03 ± 0.02	1.01 ± 0.03	1.07 ± 0.02	1.00 ± 0.04	1.01 ± 0.03	1.14 ± 0.02	1.11 ± 0.02	0.02	0.00	0.0017
	≥80	1034	1.02 ± 0.02	0.99 ± 0.04	0.99 ± 0.05	1.03 ± 0.02	0.99 ± 0.05	0.95 ± 0.03	1.12 ± 0.04	1.04 ± 0.06	0.01	0.01	0.1439

[1] Values are means ± SEs. Individual protein intakes were derived from the first of 2 nonconsecutive 24-h recalls. Body weights were adjusted to the nearest IBW for children and adults. Cycle trends were evaluated using regression analyses with cycle as the independent variable and the regression coefficient (β) representing change over time. $P \leq 0.01$ was considered significant. IBW, ideal body weight.

being observed in men aged ≥71 y; *2*) Asian and Hispanic populations aged ≥19 y have greater relative protein intake than NHB and NHW populations of the same age, whereas there were no race or ethnicity differences for relative protein intake in the 2–18 y population; *3*) adolescent females (14–18 y) and older NHB men (≥71 y) have the greatest percentage of the population below EAR and RDA recommendations; and *4*) <1% of any population group had protein intakes above the AMDR for protein.

The current analysis shows that protein intake has remained largely unchanged over the past 14 y, despite widespread publicity regarding protein-related health benefits (11) and the increased variety of protein-containing food products in the US food supply (16). Protein intakes continue to exceed both minimum population and individual protein intake requirements (i.e., EAR and RDA, respectively), but are far from exceeding the AMDR. The EAR and RDA are based on the minimum intake

TABLE 2
Usual protein intake by age, sex, and race or ethnicity from NHANES, 2011–2014[1]

	2–18 y		≥19 y		≥51 y		≥71 y	
Protein intake by sex and race/ethnicity	*n*	Mean ± SE	*n*	Mean ± SE	*n*	Mean ± SE	*n*	Mean ± SE
Combined								
Protein, g/d								
Asian	615	72.0 ± 2.7[a]	1134	81.8 ± 1.5[a]	423	75.9 ± 1.5	82	74.0 ± 3.5
NHB	1601	64.6 ± 0.7[b]	2331	81.5 ± 1.0[a]	1133	75.3 ± 1.8	235	64.6 ± 2.3
Hispanic	1881	71.6 ± 1.4[a]	2110	89.5 ± 1.3[b]	860	80.6 ± 2.1	145	69.7 ± 3.3
NHW	1433	68.0 ± 1.3[ab]	4076	82.7 ± 0.6[a]	2022	78.5 ± 0.9	832	71.4 ± 1.2
Protein, % calories								
Asian	615	15.9 ± 0.3[a]	1134	17.2 ± 0.2[a]	423	17.3 ± 0.3[a]	82	17.7 ± 0.7[a]
NHB	1601	13.9 ± 0.1[b]	2331	15.2 ± 0.1[b]	1133	15.6 ± 0.2[b]	235	16.1 ± 0.3[ab]
Hispanic	1881	14.8 ± 0.1[c]	2110	16.5 ± 0.1[a]	860	16.8 ± 0.2[a]	145	17.1 ± 0.4[a]
NHW	1433	14.2 ± 0.2[b]	4076	15.5 ± 0.2[b]	2022	15.6 ± 0.2[b]	832	15.5 ± 0.2[b]
Protein, $g \cdot kg\ IBW^{-1} \cdot d^{-1}$								
Asian	602	2.29 ± 0.11	1123	1.32 ± 0.02[a]	416	1.27 ± 0.03[a]	79	1.30 ± 0.07[a]
NHB	1582	2.03 ± 0.05	2299	1.18 ± 0.01[b]	1115	1.09 ± 0.03[b]	230	1.00 ± 0.04[b]
Hispanic	1855	2.20 ± 0.05	2091	1.35 ± 0.02[a]	853	1.24 ± 0.03[a]	144	1.12 ± 0.05[ab]
NHW	1417	2.04 ± 0.04	4033	1.18 ± 0.01[b]	1990	1.14 ± 0.01[b]	807	1.09 ± 0.02[b]
Females								
Protein, g/d								
Asian	321	65.7 ± 2.2	561	70.4 ± 1.7[ab]	218	67.0 ± 1.9	39	64.8 ± 4.1
NHB	776	60.5 ± 1.2	1196	69.4 ± 0.9[ab]	575	64.8 ± 1.2	114	59.8 ± 2.7
Hispanic	937	64.4 ± 1.7	1076	72.7 ± 1.2[a]	437	67.0 ± 2.0	76	59.8 ± 3.3
NHW	692	59.9 ± 1.2	2040	67.4 ± 0.6[b]	1049	66.3 ± 0.9	426	62.2 ± 1.4
Protein, % calories								
Asian	321	15.4 ± 0.3[a]	561	16.8 ± 0.3[a]	218	16.8 ± 0.4[a]	39	16.7 ± 0.8[ab]
NHB	776	13.9 ± 0.1[b]	1196	14.8 ± 0.1[b]	575	15.3 ± 0.2[b]	114	16.0 ± 0.5[ab]
Hispanic	937	14.7 ± 0.2[a]	1076	16.3 ± 0.2[a]	437	16.7 ± 0.3[a]	76	17.1 ± 0.6[a]
NHW	692	13.8 ± 0.3[b]	2040	15.2 ± 0.2[b]	1049	15.4 ± 0.2[b]	426	15.1 ± 0.2[b]
Protein, $g \cdot kg\ IBW^{-1} \cdot d^{-1}$								
Asian	315	2.17 ± 0.12	555	1.27 ± 0.03[a]	216	1.23 ± 0.03[a]	37	1.25 ± 0.09
NHB	768	1.97 ± 0.05	1177	1.08 ± 0.01[b]	566	1.01 ± 0.02[b]	110	1.01 ± 0.05
Hispanic	926	2.06 ± 0.06	1064	1.21 ± 0.02[a]	431	1.15 ± 0.03[ac]	75	1.04 ± 0.06
NHW	685	1.88 ± 0.06	2017	1.07 ± 0.01[b]	1036	1.07 ± 0.01[c]	418	1.04 ± 0.02
Males								
Protein, g/d								
Asian	294	78.5 ± 4.0[ab]	573	93.8 ± 2.4[a]	205	87.4 ± 2.4	43	85.1 ± 5.3[ab]
NHB	825	68.8 ± 1.1[a]	1135	95.9 ± 2.4[a]	558	87.8 ± 3.4	121	71.5 ± 3.6[a]
Hispanic	944	78.4 ± 1.6[b]	1034	106.2 ± 2.3[b]	423	95.6 ± 3.1	69	84.5 ± 5.0[ab]
NHW	741	75.6 ± 1.7[b]	2036	97.9 ± 0.9[a]	973	92.4 ± 1.3	406	83.1 ± 1.4[b]
Protein, % calories								
Asian	294	16.3 ± 0.4[a]	573	17.6 ± 0.4[a]	205	17.9 ± 0.5[a]	43	19.0 ± 0.9[a]
NHB	825	13.9 ± 0.2[b]	1135	15.6 ± 0.2[b]	558	15.8 ± 0.2[b]	121	16.4 ± 0.5[b]
Hispanic	944	14.9 ± 0.1[c]	1034	16.8 ± 0.2[a]	423	16.9 ± 0.2[a]	69	17.2 ± 0.5[ab]
NHW	741	14.5 ± 0.2[bc]	2036	15.7 ± 0.2[b]	973	15.8 ± 0.2[b]	406	16.0 ± 0.3[b]
Protein, $g \cdot kg\ IBW^{-1} \cdot d^{-1}$								
Asian	287	2.40 ± 0.17	568	1.38 ± 0.04[ab]	200	1.34 ± 0.04[a]	42	1.34 ± 0.09[a]
NHB	814	2.10 ± 0.07	1122	1.29 ± 0.03[b]	549	1.19 ± 0.04[ab]	120	0.99 ± 0.04[b]
Hispanic	929	2.33 ± 0.05	1027	1.48 ± 0.03[a]	422	1.35 ± 0.05[ab]	69	1.22 ± 0.07[a]
NHW	732	2.21 ± 0.06	2016	1.29 ± 0.01[b]	954	1.23 ± 0.02[b]	389	1.15 ± 0.02[a]

[1]Values are means ± SEs. Usual protein intakes were derived from 2 nonconsecutive 24-h recalls using the National Cancer Institute method (18). Body weights were adjusted to the nearest IBW for children and adults. Differences between race or ethnicity groups were evaluated using the z statistic. Different lowercase letters within an age and sex category indicate significant differences, $P \le 0.01$. IBW, ideal body weight; NHB, non-Hispanic black; NHW, non-Hispanic white.

of protein necessary to prevent deficiency (i.e., negative nitrogen balance) in 50% of the population and 97.5% of individuals, respectively (1); however, consuming protein above these minimum requirements may provide health benefits (19). Adequate protein is critical for growth and development in children and adolescents (1), with some evidence suggesting that higher-protein intake (19.9% compared with 16.8% of total energy) in this age group (5–18 y) may improve waist circumference and LDL cholesterol concentrations (20). Higher-protein diets, particularly in the context of low dietary acid loads, have been positively associated with bone circumference, content, and strength in children and adolescents (21). In adults,

TABLE 3
Percentage of the population above and below DRI standards for protein by age and sex from NHANES 2011–2014[1]

Age, y	Sex	*n*	Below EAR, %	Below RDA, %	Below AMDR, %	Above AMDR, %
2–3	Combined	790	0.00 ± 0.00	0.00 ± 0.01	0.00 ± 0.00	0.96 ± 0.45
4–8	Combined	1808	0.00 ± 0.01	0.04 ± 0.03	2.57 ± 1.40	0.00 ± 0.00
9–13	Female	829	1.83 ± 0.59	6.92 ± 1.40*	1.92 ± 1.22	0.00 ± 0.00
14–18	Female	760	11.48 ± 2.26	23.36 ± 2.88*	1.12 ± 0.93	0.00 ± 0.00
19–30	Female	984	4.51 ± 0.66*	14.01 ± 1.34*	2.07 ± 0.58	0.00 ± 0.00
31–50	Female	1683	4.10 ± 0.74*	13.23 ± 1.41*	1.40 ± 0.47	0.00 ± 0.00
51–70	Female	1637	5.34 ± 0.68*	15.59 ± 1.07*	1.03 ± 0.35	0.00 ± 0.00
≥71	Female	650	6.87 ± 1.12	19.21 ± 2.11	1.54 ± 0.45	0.00 ± 0.00
≥80	Female	271	5.68 ± 1.19	16.74 ± 2.47	1.27 ± 0.42	0.00 ± 0.00
9–13	Male	838	0.51 ± 0.20	2.31 ± 0.67	1.10 ± 0.61	0.00 ± 0.00
14–18	Male	776	5.32 ± 1.20	11.26 ± 1.85	0.65 ± 0.52	0.00 ± 0.00
19–30	Male	1103	0.59 ± 0.20	2.75 ± 0.62	0.60 ± 0.25	0.00 ± 0.00
31–50	Male	1620	1.01 ± 0.27	4.27 ± 0.71	0.59 ± 0.22	0.00 ± 0.00
51–70	Male	1536	1.92 ± 0.53	7.17 ± 1.23	0.62 ± 0.24	0.00 ± 0.00
≥71	Male	634	4.48 ± 0.84	13.17 ± 1.33	0.47 ± 0.25	0.00 ± 0.00
≥80	Male	258	5.90 ± 1.58	16.86 ± 2.85	1.00 ± 0.39	0.00 ± 0.00

[1]Values are means ± SEs. *Significant difference from males of the same age based on the z statistic, $P \leq 0.01$. AMDR, Acceptable Macronutrient Distribution Range; DRI, Dietary Reference Intake; EAR, Estimated Average Requirement; RDA, Recommended Dietary Allowance.

higher-protein diets promote maintenance of bone mass and integrity (22–24), preservation and enhancement of muscle mass and function in response to a variety of conditions (e.g., exercise, weight loss, and aging) (13, 25–27), and postabsorptive and postprandial glycemic regulation (28–31).

The AMDR, which is a designated range of intake for each macronutrient as a percentage of total energy intake at a level determined to both prevent deficiency and minimize the likelihood of developing chronic diseases (1), may be a more appropriate benchmark of optimal protein intake (children aged 1–3 y: 5–20%, children/adolescents aged 4–18 y: 10–30%, adults aged ≥19 y: 10–35% of total energy intake) (19). In the current analysis, protein comprised 14–16% of total energy intake for all age groups (ethnicity and race combined analyses, Figure 1), with <1% of any population group consuming protein above the AMDR. In adults (≥19 y), current protein intakes (15–16% of total energy intake) are ≥19 percentage points below the upper end of the AMDR for protein (i.e., 35% of total energy intake), indicating protein consumption, as a percentage of total energy intake, is not excessive in the American diet. Asian males aged ≥71 y had the greatest percentage protein intake, at 19% of total energy, which is still well below the upper end of the AMDR. Population-wide dietary guidelines and individual dietary advice can safely recommend moderate increases in protein consumption to optimize health, with minimal risk of exceeding the AMDR.

The only population to have a consistent, albeit small, change in protein intake over the past 14 y were men aged ≥71 y. Protein intake increased in this group by 1.15 g/d, 0.02 g · kg IBW^{-1} · d^{-1}, and 0.14% of total energy every 2 y cycle from 2001 to 2014. Despite the increase, 4% of this demographic did not meet the EAR for protein and 13% had usual intakes that did not meet the RDA. Furthermore, 7% of females aged ≥71 y did not meet the EAR for protein and 19% had usual intakes that did not meet the RDA. Adequate protein intake is especially important in this demographic because aging individuals are at risk for sarcopenia, muscle wasting, and frailty (32), all of which are exacerbated by inadequate protein intake (33). Consuming an additional 10–35 g/d of protein improves muscle protein synthesis (34), physical strength and function (35, 36), and lean body mass (34–36) in older adults. Higher-protein diets (1.0–1.2 g · kg^{-1} · d^{-1}) are advised for older individuals to ensure consumption of 25–30 g protein/meal, which has been shown to produce an anabolic stimulus similar to that observed in younger individuals (37–39). Dietary interventions to increase protein intake in this age group may improve age-related morbidity.

A sizable percentage of the population aged 14–18 y, particularly females, did not meet the EAR for protein (11% of females, 5% of males) and had usual intakes that did not meet the current RDA (23% of females, 11% of males). Compared with our previous analysis (NHANES 2003–2004), in which 8% of females and <3% of males did not meet the EAR, the current findings indicate a slight increase in those not meeting the EAR for both males and females (10). More independence in making food choices and the high prevalence of dieting in this age group, particularly in females, may contribute to the occurrence of inadequate protein intake. In a cohort of adolescents (n = 2287; aged ∼13–16 y), 55–58% of females and 22–29% of males reported dieting in the past year (40). In another study (41), dietary intake was assessed in preadolescence (11 y) and then again in adolescence (15.5 y); it was reported that during adolescence, females (n = 643) consumed less meat and dairy, whereas males (n = 589) ate less dairy but more meat. Adequate dietary protein remains important for growth and development in this demographic (14–18 y), despite slowed growth rates after puberty (42). An emphasis on nutrition education, particularly related to choosing lower-energy, nutrient-dense foods, may benefit this population.

In the current study, we found no race or ethnicity differences in relative protein intake for the population aged 2–18 y. However, relative protein intake in the population aged ≥19 y was greater for Asian and Hispanic individuals (1.32 and 1.35 g protein · kg · IBW^{-1} · d^{-1}, respectively) than NHB and NHW individuals (1.18 g protein · kg · IBW^{-1} · d^{-1} for both). Ethnic and racial disparities were particularly evident in ≥71-y-old NHB men who

TABLE 4
Percentage of the population above and below DRI standards for protein by age, sex, and race/ethnicity from NHANES, 2011–2014[1]

Age, sex, and race/ethnicity	n	Below EAR, %	Below RDA, %	Below AMDR, %	Above AMDR, %
2–18 y					
Combined					
Asian	602	0.52 ± 0.54[a]	2.02 ± 1.15[a]	0.27 ± 0.51	0.63 ± 0.36
NHB	1582	5.20 ± 0.86[b]	10.47 ± 1.14[b]	0.47 ± 0.74	0.01 ± 0.02
Hispanic	1855	1.63 ± 0.53[a]	4.19 ± 0.90[ac]	0.05 ± 0.07	0.02 ± 0.02
NHW	1417	3.05 ± 1.03[ab]	7.08 ± 1.58[bc]	3.10 ± 1.88	0.21 ± 0.10
Females					
Asian	315	0.80 ± 0.74[a]	2.92 ± 1.65[a]	0.37 ± 0.64	0.50 ± 0.37
NHB	768	6.15 ± 1.11[b]	12.41 ± 1.48[b]	0.51 ± 0.75	0.02 ± 0.02
Hispanic	926	2.52 ± 0.72[a]	6.32 ± 1.30[ac]	0.04 ± 0.08	0.01 ± 0.02
NHW	685	4.34 ± 1.51[ab]	10.11 ± 2.20[bc]	4.19 ± 2.60	0.13 ± 0.06
Males					
Asian	287	0.34 ± 0.44[a]	1.19 ± 0.94[a]	0.18 ± 0.39	0.65 ± 0.44
NHB	814	4.34 ± 0.82[b]	8.72 ± 1.26[b]	0.47 ± 0.73	0.01 ± 0.02
Hispanic	929	0.97 ± 0.35[a]	2.47 ± 0.67[a]	0.03 ± 0.07	0.02 ± 0.02
NHW	732	1.54 ± 0.62[a]	3.86 ± 1.09[a]	2.10 ± 1.17	0.25 ± 0.17
≥19 y					
Combined					
Asian	1123	1.30 ± 0.44[a]	5.10 ± 1.01[a]	0.12 ± 0.22[a]	0.01 ± 0.01
NHB	2299	4.69 ± 0.83[b]	13.43 ± 1.35[b]	1.02 ± 0.43[ab]	0.00 ± 0.00
Hispanic	2091	1.71 ± 0.53[ac]	6.03 ± 1.15[a]	0.45 ± 0.21[ab]	0.00 ± 0.00
NHW	4033	3.43 ± 0.51[bc]	11.07 ± 0.91[b]	1.38 ± 0.40[b]	0.00 ± 0.00
Females					
Asian	555	1.87 ± 0.60[a]	6.76 ± 1.29[a]	0.10 ± 0.26[a]	0.00 ± 0.00
NHB	1177	6.08 ± 1.33[b]	17.33 ± 2.06[b]	0.95 ± 0.65[ab]	0.00 ± 0.00
Hispanic	1064	2.49 ± 0.96[ab]	8.86 ± 2.06[a]	0.42 ± 0.28[ab]	0.00 ± 0.00
NHW	2017	5.38 ± 0.78[b]	16.23 ± 1.35[b]	2.18 ± 0.68[b]	0.00 ± 0.00
Males					
Asian	568	0.68 ± 0.52	3.45 ± 1.44[ab]	0.17 ± 0.23	0.02 ± 0.02
NHB	1122	2.87 ± 0.85	8.61 ± 1.64[a]	1.16 ± 0.61	0.00 ± 0.00
Hispanic	1027	0.88 ± 0.33	3.35 ± 0.79[b]	0.51 ± 0.31	0.00 ± 0.01
NHW	2016	1.53 ± 0.61	5.85 ± 1.36[ab]	0.55 ± 0.27	0.00 ± 0.00
≥51 y					
Combined					
Asian	416	1.92 ± 0.67[a]	6.84 ± 1.55[a]	0.09 ± 0.25[a]	0.01 ± 0.01
NHB	1115	7.15 ± 1.14[b]	18.96 ± 1.90[b]	0.69 ± 0.30[ab]	0.00 ± 0.00
Hispanic	853	2.85 ± 0.91[a]	9.18 ± 1.96[ac]	0.33 ± 0.20[ab]	0.00 ± 0.01
NHW	1990	4.03 ± 0.69[ab]	12.58 ± 1.25[c]	1.22 ± 0.33[b]	0.00 ± 0.00
Females					
Asian	216	2.45 ± 0.94[a]	8.83 ± 1.95[a]	0.09 ± 0.32	0.00 ± 0.00
NHB	566	8.93 ± 1.62[b]	23.39 ± 2.43[b]	0.44 ± 0.40	0.00 ± 0.00
Hispanic	431	4.01 ± 1.42[ab]	12.45 ± 2.87[ac]	0.30 ± 0.26	0.00 ± 0.00
NHW	1036	5.38 ± 0.89[ab]	16.34 ± 1.59[bc]	1.80 ± 0.59	0.00 ± 0.00
Males					
Asian	200	1.02 ± 0.66[a]	4.40 ± 1.85[a]	0.15 ± 0.22	0.01 ± 0.04
NHB	549	5.05 ± 1.30[b]	13.32 ± 2.24[b]	0.92 ± 0.56	0.00 ± 0.00
Hispanic	422	1.85 ± 0.79[ab]	6.06 ± 1.72[ab]	0.44 ± 0.31	0.00 ± 0.01
NHW	954	2.26 ± 0.91[ab]	8.10 ± 1.83[ab]	0.56 ± 0.26	0.00 ± 0.00
≥71 y					
Combined					
Asian	79	1.43 ± 1.19[a]	5.40 ± 3.34[a]	0.07 ± 0.20[a]	0.01 ± 0.07
NHB	230	11.12 ± 2.46[b]	26.39 ± 4.21[b]	0.42 ± 0.23[ab]	0.00 ± 0.00
Hispanic	144	5.91 ± 2.19[ab]	16.39 ± 4.38[ab]	0.18 ± 0.20[a]	0.00 ± 0.01
NHW	807	5.47 ± 0.98[b]	16.13 ± 1.79[b]	1.53 ± 0.43[b]	0.00 ± 0.00
Females					
Asian	37	2.22 ± 1.68	7.26 ± 4.38	0.05 ± 0.40[a]	0.00 ± 0.01
NHB	110	9.08 ± 3.10	24.07 ± 5.49	0.18 ± 0.27[a]	0.00 ± 0.00
Hispanic	75	7.66 ± 2.89	20.92 ± 5.67	0.18 ± 0.22[a]	0.00 ± 0.01
NHW	418	6.94 ± 1.37	19.67 ± 2.53	2.30 ± 0.68[b]	0.00 ± 0.00
Males					
Asian	42	1.02 ± 0.75[a]	4.17 ± 2.22[a]	0.06 ± 0.10	0.04 ± 0.09
NHB	120	13.22 ± 3.23[b]	29.43 ± 4.90[b]	0.53 ± 0.48	0.00 ± 0.00
Hispanic	69	3.55 ± 2.13[ab]	10.59 ± 4.58[ac]	0.40 ± 0.26	0.01 ± 0.02
NHW	389	3.68 ± 1.10[a]	11.84 ± 1.97[c]	0.38 ± 0.26	0.00 ± 0.00

[1]Values are mean ± SE. Differences between race or ethnicity groups were evaluated using the z statistic. Different lowercase letters within an age and sex category indicate significant differences, $P \leq 0.01$. AMDR, Acceptable Macronutrient Distribution Range; DRI, Dietary Reference Intake; EAR, Estimated Average Requirement NHB, non-Hispanic black; NHW, non-Hispanic white; RDA, Recommended Dietary Allowance.

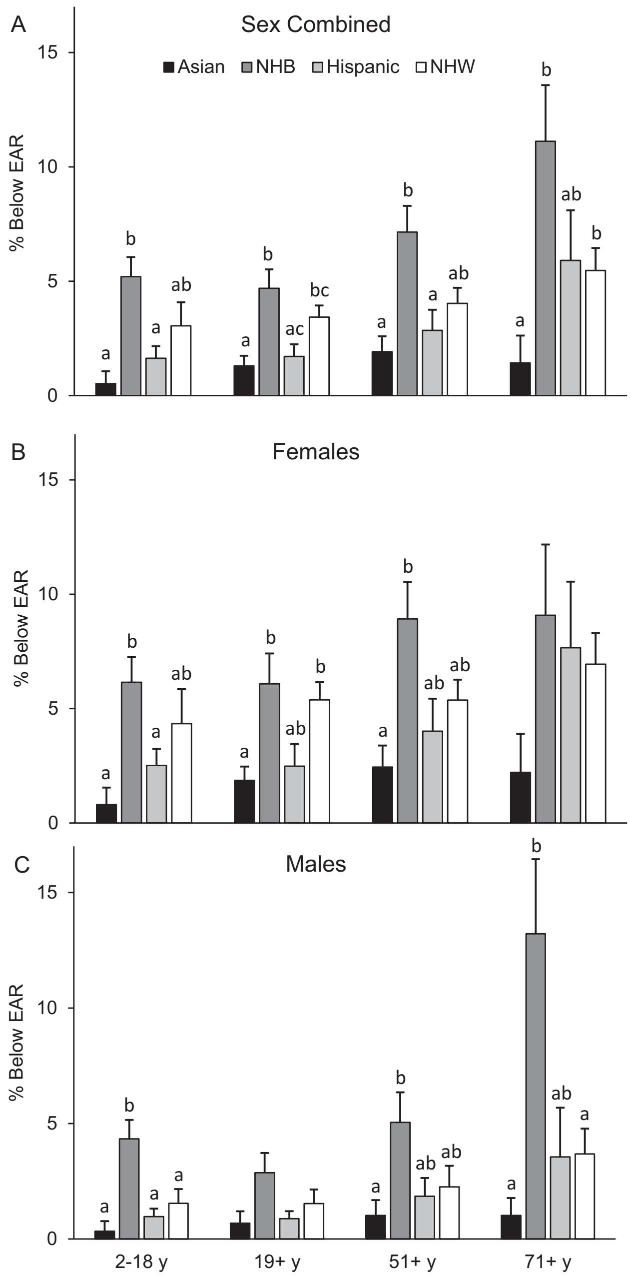

FIGURE 2 Percentage of the population (mean ± SE) below the EAR for protein intake by race or ethnicity and age (NHANES, 2011–2014; $n = 15{,}177$) in both sexes (A), females (B), and males (C). Differences between race or ethnicity groups were evaluated using the z statistic. Different lowercase letters within an age and sex category indicate significant differences, $P \leq 0.01$. EAR, Estimated Average Requirement; NHB, non-Hispanic black; NHW, non-Hispanic white.

consumed less protein (0.99 ± 0.04 g · kg IBW^{-1} · d^{-1}) than Asian, Hispanic, and NHW men ($\geq 1.15 \pm 0.02$ g · kg IBW^{-1} · d^{-1}) of the same age group and had a disproportionately higher population percentage falling below the EAR (13%) and not meeting the RDA (29%) for protein. The reason for this disparity is unclear, but does not seem related to food insecurity. Based on findings from one systematic review (43), total protein intake was unaffected by food insecurity in adults and children. However, food insecurity may adversely affect intake of specific protein foods, such as dairy products (43). Future analyses should evaluate specific food groups and patterns to characterize differences in both quantity and quality of protein intake by race and ethnicity.

The strengths of the current analysis include the large sample size, comprehensive nature of the NHANES database, and protein intake comparisons by race and ethnicity. However, despite total sample size, analyses for several ethnicities (i.e., Asian and Hispanic) and older (i.e., ≥71 y) population groups may be limited by demographic-specific sample sizes. In addition, the current analysis does not assess source-specific protein intake. On average, Americans meet or exceed guidelines for total protein intake; however, source-specific protein intake is below guidelines for dairy (all age groups except 1–3 y) and seafood, and only meets or falls below guidelines for nuts, seeds, soy products, and legumes (44).

The majority of the US population is meeting or exceeding minimum population recommendations for protein intake. Dietary protein intake remains well below the upper end of the AMDR, indicating current protein consumption is within recommended ranges and not excessive. Finally, a considerable percentage of adolescent females (14–18 y) and older adults (≥71 y), particularly older NHB males, fall below the EAR and RDA. Targeted interventions and education may be necessary to ensure these demographic groups are, at the very least, meeting minimum protein recommendations and, ideally, consuming protein at levels to optimize health.

The authors' responsibilities were as follows—CEB and SMP: wrote the manuscript; VLF: analyzed the data; SMP: had primary responsibility for the final content; and all authors: designed the research, conducted the research, and read and approved the final manuscript. VLF performs consulting and database analyses for various food and beverage companies and related entities as Senior Vice President of Nutrition Impact; the remaining authors had no conflicts of interest related to the study.

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