

Current protein intake in America: analysis of the National Health and Nutrition Examination Survey, 2003–2004^{1–4}

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ABSTRACT

In recent years there has been considerable interest in the benefits of high-protein diets. This study determined current usual intake of protein in America. Using the most recent data from the National Health and Nutrition Examination Survey, 2003–2004, usual protein intake for Americans aged 2+ years was estimated. Usual protein intake was calculated on a grams per day, grams per kilogram ideal body weight, and a percentage of calories basis. Protein intake averaged 56 ± 14 g/d in young children, increased to a high of $\approx 91 \pm 22$ g/d in adults aged 19–30 y, and decreased to $\approx 66 \pm 17$ g/d in the elderly. The percentage of the male population who consumed less than the estimated average requirement was very low. Our estimates indicated that 7.7% of adolescent females and 7.2–8.6% of older adult women reported consuming protein levels below their estimated average requirement. The median intake of protein on a percentage of calories basis ranged from 13.4% in children aged 4–8 y to 16.0% in men aged 51–70 y. Even the 95th percentile of protein intake did not approach the highest acceptable macronutrient distribution range of 35% for an age/sex group. The highest 95th percentile of protein intake was 20.8% of calories in men aged 51–70 y. Given the demonstrated benefits of higher protein intake on weight management, sarcopenia, and other physiologic functions, efforts should be undertaken to ensure that Americans consume the recommended amount of protein (17–21% of calories as expected from MyPyramid food patterns). *Am J Clin Nutr* 2008; 87(suppl):1554S–7S.

INTRODUCTION

Protein intake can be measured various ways: grams per day, grams per kilogram body weight as per the dietary reference intakes (DRIs), or as a percentage of calories (1). In addition, protein sources can be measured via food sources in ounces of meat and meat alternatives as in the older Food Guide Pyramid or as in the newer MyPyramid protein equivalents per day (2, 3). The estimated average requirement (EAR) is set on a grams per kilogram basis, and only a few Americans have been reported to consume less than the EAR; thus, protein malnutrition is not considered to be prevalent in America (1). Although protein malnutrition may not be an issue, the question remains as to whether higher levels of protein intake are helpful for certain segments of the population, the elderly in particular, or provide some benefit in managing chronic diseases such as obesity and diabetes.

Moshfegh et al (4) reported usual protein intake in grams per kilogram body weight from the National Health and Nutrition Survey (NHANES) 2001–2002. For all subjects aged 1 y or older, usual protein intake was 1.5 ± 0.04 g/kg. The highest protein intake of 4.4 ± 0.10 g/kg was reported in young children, and the lowest protein intake of 1.0 ± 0.02 g/kg was reported in older women. Very few men reported protein intakes less than the EAR. However, 13% of adolescent females 14–18 y of age and 11% of women 71 y or older had usual intakes less than the EAR.

Another measure of protein intake is the acceptable macronutrient distribution range (AMDR), which is 5–35% calories from protein, depending on age. The US Department of Agriculture dietary patterns for MyPyramid used the DRIs and AMDRs to establish nutritional goals for protein intake. On a grams per day basis, the lowest protein intake goal was 13 g/d for young children and the highest protein intake goal was 56 g/d for adult men. The goal on a percentage of calories basis ranged from 5% to 20% for young children and from 10% to 35% in adults (5). The expected estimate of the protein intake in the MyPyramid food patterns ranged from 44 to 126 g protein/d, depending on calorie levels (which was 1.7 to 3.5 times the recommended dietary allowance for protein). As a percentage of calories, the expected estimated intake of protein from the MyPyramid food pattern ranged from 17% to 21% of calories (6). The expected protein intake from the MyPyramid food patterns only approaches the midpoint of the AMDR of 5–35%; thus higher protein intakes could be safely recommended.

The US Department of Agriculture Food Guide Pyramid recommended 5–7 ounces of meat or meat alternatives per day (2). Cook and Friday (7) reported, from 1 d of intake, that Americans 2 y and older consumed an average of 5.3 ounces of meat or meat alternatives. The range of intake was 2.6 ounces for young female children to 7.9 ounces for men aged 30–39 y. Ten percent of Americans 2 y and older consumed <1 ounce of meat or meat

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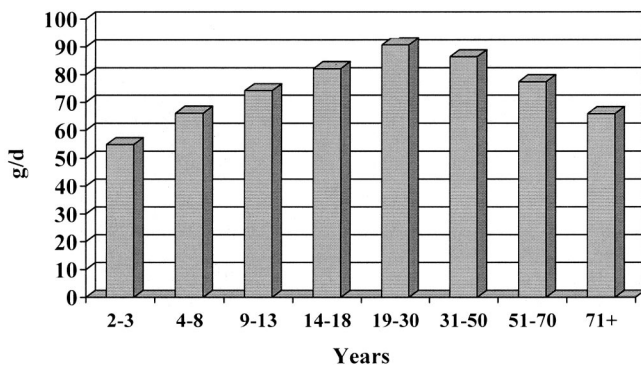


FIGURE 1. Protein intake (g/d) by age—NHANES, 2003–2004.

alternatives, whereas only 44% of this group consumed the minimum number of ounces of meat or meat alternatives. Only 37% of women aged 20 y and older consumed at least the minimum number of ounces of meat or meat alternatives (62% of men aged 20 y and older consumed at least the minimum number of ounces of meat or meat alternatives).

Given the commonly held belief that protein consumption by Americans is excessive, protein intakes were estimated by using the most recently available data to determine current usual protein intake in Americans on a grams per day, on a grams per kilogram body weight, and on a percentage of calories basis.

MATERIALS AND METHODS

Data used were from the NHANES release from 2003 to 2004. In this release 24-h dietary recalls for 2 days of food and nutrient intake were made available. The first day of intake was collected in the Mobile Examination Center using the automated multiple pass method, whereas the second day of intake was collected via a telephone interview 3–10 days later (8). A minimum of 2 nonconsecutive days of intake is required to estimate usual intake. Experts recommend that the assessment of diets of population groups to

DRI be based on usual intake (1). Usual protein intake distribution was determined with the use of specialized software, Software for Intake Distribution Estimation (9), which adjusts for interday variation in intake. Both days of protein intake estimates were used as data sources for Software for Intake Distribution Estimation analysis. Usual protein intake was estimated 3 ways: 1) grams of protein per day, 2) grams of protein per kilogram ideal body weight, and 3) percentage of energy from protein. For grams of protein per kilogram ideal body weight calculations, body weights were adjusted to the nearest ideal body weight. Namely, for adults who were overweight/obese, body weights were adjusted to a body mass index (BMI) of 24.9 kg/m² and for adults who were underweight, body weights were adjusted to a BMI of 18.5 kg/m². 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%. Because standing height was not available for children 2–3 y of age, missing body weight was set at 12 kg, the reference amount for this group (1). Individuals were grouped by age/sex groups used by the DRI panels (1). For the purposes of this research, data were not separated by ethnicity. Means, SDs, and percentiles of distribution were generated using SAS version 9.1 (10), SUDAAN version 9.0 (11), or Software for Intake Distribution Estimation (9) with appropriate sample weights to adjust for the complex sample design of NHANES.

RESULTS

As shown in **Figure 1**, protein intake averaged 55 ± 14 g/d in young children, increased to a high of $\approx 91 \pm 22$ g/d in adults aged 19–30 y, and then decreased to $\approx 66 \pm 17$ g/d in older adults (71+ years). Median intakes for the groups were 53, 89, and 63 g/d, respectively. Averages and percentiles of protein intake by age/sex group are presented in **Table 1**.

Average protein intake on a gram per kilogram ideal body weight basis, the actual DRI format, is presented in **Figure 2**.

TABLE 1

Protein (g/d): usual intakes from food, compared to estimated average requirement (EAR)¹

	Mean \pm SD	Percentiles							EAR	Percentage less than EAR
		5	10	25	50	75	90	95		
Males and females										
2–3 y (n = 375)	54.9 \pm 13.8	35.6	39.1	45.5	53.4	62.6	72.5	79.3	10.8	<3
4–8 y (n = 726)	66.1 \pm 13.7	45.7	49.6	56.5	65.0	74.6	84.1	90.2	15.2	<3
Males										
9–13 y (n = 452)	80.9 \pm 17.6	54.6	59.6	68.6	79.6	91.7	103.9	111.9	27.2	<3
14–18 y (n = 638)	96.5 \pm 25.2	59.5	66.4	78.9	94.3	111.7	129.5	141.3	44.7	<3
19–30 y (n = 475)	109.2 \pm 25.8	70.6	78.0	91.1	107.1	125.0	143.1	154.9	46.2	<3
31–50 y (n = 634)	104.3 \pm 23.7	68.4	75.5	87.9	102.6	118.9	135.3	146.1	46.2	<3
51–70 y (n = 556)	88.3 \pm 22.1	55.9	61.9	72.8	86.2	101.4	117.1	127.7	46.2	<3
71+ y (n = 399)	73.4 \pm 18.2	45.4	50.8	60.5	72.3	85.0	97.3	105.1	46.2	5.6
Females										
9–13 y (n = 478)	67.5 \pm 15.5	44.1	48.7	56.7	66.4	77.1	87.7	94.7	27.2	<3
14–18 y (n = 578)	67.9 \pm 17.3	42.3	47.2	55.9	66.2	78.2	90.8	98.9	46.0	8.6
19–30 y (n = 399)	72.1 \pm 18.1	45.7	50.6	59.5	70.4	82.8	95.8	104.6	38.0	<3
31–50 y (n = 618)	68.5 \pm 16.6	44.1	48.7	56.9	66.9	78.3	90.2	98.1	38.0	<3
51–70 y (n = 618)	66.7 \pm 18.8	38.8	44.1	53.5	65.1	78.0	91.2	100.0	38.0	4.4
71+ y (n = 419)	58.6 \pm 14.7	37.1	41.2	48.4	57.2	67.1	77.5	84.6	38.0	5.9

¹ Data from individuals with two days of reliable intakes from NHANES 2003–2004. Results generated using SIDE program.

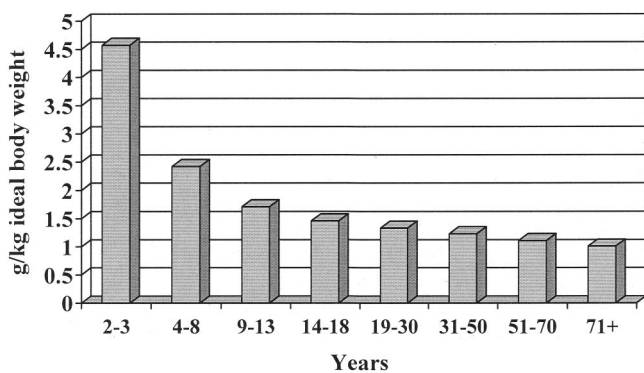


FIGURE 2. Protein intake (g/kg body weight)—NHANES, 2003–2004.

Young children 2–3 and 4–8 y of age had average intakes of protein of 4.5 ± 1.1 and 2.4 ± 1.1 g/kg ideal body weight, which is much higher than the EARs of 0.9 and 0.8 g/kg body weight, respectively. In adolescents, average protein intakes ranged from 1.7 ± 0.7 and 1.5 ± 0.6 g/kg ideal body weight for those aged 9–13 and 14–18 y, respectively. In adults, average protein intakes ranged from 1.0 ± 0.3 g/kg ideal body weight in those 71+ years of age to 1.3 ± 0.4 g/kg ideal body weight in those 19–30 y of age. Median intakes were 1.0 g/kg ideal body weight in adults 71+ years of age and 1.3 g/kg ideal body weight in adults 19–30 y of age.

The percentage of the population who consumed less than the EAR for protein was very low for men, but 7.7% of adolescent females reported consuming less than the EAR for protein. Additionally, 7.2–8.6% of older adult women reported consuming protein levels below the EAR (Table 2).

The AMDR for protein is 5–35% of calories, depending on age (the high end of the AMDR is 35% of calories). The average percentage of energy from protein ranged from 13.5% of calories

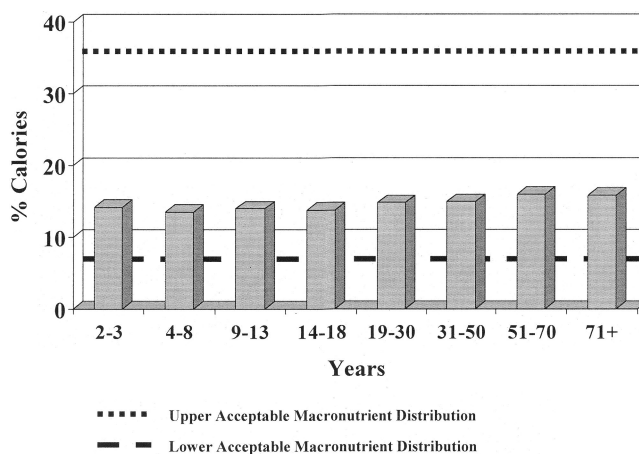


FIGURE 3. Protein intake (% of calories)—NHANES, 2003–2004.

in children 4–8 y of age and 16.0% of calories in adults 51–70 y of age (Figure 3).

The median intake of protein on a percentage of calories basis ranged from 13.4% in children 4–8 y of age to 16.0% in men 51–70 y of age (Table 3). The 95th percentile of protein intake did not approach the highest AMDR of 35% for any age/sex group. The 95th percentile of protein intake was 20.8% of calories in men 51–70 y of age.

DISCUSSION

Although most age/sex groups appear to consume more protein than the respective EAR, a significant percentage of adolescent females and older women appeared to have inadequate protein intake. These results were similar to those of Moshfegh et al (4), who observed that most men met the EAR, whereas some

TABLE 2

Protein (g/kg ideal body weight): usual intakes from food, compared to estimated average requirement (EAR)¹

	Mean \pm SD	Percentiles							EAR	Percentage less than EAR
		5	10	25	50	75	90	95		
Males and females										
2–3 (<i>n</i> = 374)	4.6 \pm 1.2	2.9	3.2	3.8	4.4	5.2	6.1	6.7	0.9	<3
4–8 (<i>n</i> = 722)	2.4 \pm 1.1	0.9	1.1	1.6	2.3	3.1	3.9	4.6	0.8	<3
Males										
9–13 (<i>n</i> = 451)	1.9 \pm 0.7	0.9	1.1	1.4	1.8	2.3	2.8	3.3	0.8	<3
14–18 (<i>n</i> = 633)	1.7 \pm 0.7	0.8	1.0	1.2	1.5	2.0	2.5	3.0	0.7	<3
19–30 (<i>n</i> = 470)	1.5 \pm 0.4	0.9	1.0	1.2	1.4	1.7	2.0	2.2	0.7	<3
31–50 (<i>n</i> = 624)	1.4 \pm 0.3	0.9	1.0	1.2	1.4	1.6	1.8	1.9	0.7	<3
51–70 (<i>n</i> = 555)	1.2 \pm 0.3	0.8	0.8	1.0	1.1	1.3	1.5	1.7	0.7	<3
71+ (<i>n</i> = 391)	1.0 \pm 0.3	0.7	0.7	0.9	1.0	1.2	1.4	1.5	0.7	<3
Females										
9–13 (<i>n</i> = 476)	1.5 \pm 0.7	0.7	0.8	1.0	1.4	1.9	2.4	2.8	0.8	7.7
14–18 (<i>n</i> = 570)	1.2 \pm 0.5	0.7	0.8	0.9	1.2	1.5	1.8	2.1	0.7	7.7
19–30 (<i>n</i> = 393)	1.2 \pm 0.3	0.7	0.8	1.0	1.2	1.4	1.6	1.8	0.7	<3
31–50 (<i>n</i> = 612)	1.1 \pm 0.3	0.7	0.8	0.9	1.1	1.3	1.5	1.6	0.7	4.0
51–70 (<i>n</i> = 606)	1.1 \pm 0.3	0.6	0.7	0.9	1.0	1.2	1.5	1.6	0.7	7.2
71+ (<i>n</i> = 406)	1.0 \pm 0.3	0.6	0.7	0.8	0.9	1.1	1.3	1.4	0.7	8.6

¹ Data from individuals with two days of reliable intake from NHANES 2003–2004. Body weights adjusted to nearest ideal bodyweight for both children and adults. Results generated using SIDE program.

TABLE 3

Protein (% kcal): usual intakes from food, compared to acceptable macronutrient distribution range (AMDR)¹

	Mean ± SD	Percentiles							Low AMDR	Prob Below	High AMDR	Prob Above
		5	10	25	50	75	90	95				
Males and females												
2-3 (n = 375)	14.2 ± 1.7	11.6	12.1	13.0	14.1	15.3	16.5	17.2	5	<3	20	<3
4-8 (n = 726)	13.5 ± 1.6	11.1	11.6	12.4	13.4	14.5	15.6	16.2	10	<3	30	<3
Males												
9-13 (n = 452)	13.9 ± 1.2	12.0	12.4	13.1	13.9	14.7	15.5	15.9	10	<3	30	<3
14-18 (n = 638)	14.1 ± 1.8	11.3	11.8	12.8	14.0	15.3	16.5	17.3	10	<3	30	<3
19-30 (n = 475)	15.3 ± 2.2	11.9	12.6	13.7	15.1	16.6	18.2	19.2	10	<3	35	<3
31-50 (n = 634)	15.1 ± 2.2	11.7	12.4	13.6	15.0	16.5	18.0	19.1	10	<3	35	<3
51-70 (n = 556)	16.2 ± 2.6	12.3	13.1	14.4	16.0	17.9	19.7	20.8	10	<3	35	<3
71+ (n = 399)	15.9 ± 1.7	13.2	13.7	14.7	15.9	17.1	18.2	18.9	10	<3	35	<3
Females												
9-13 (n = 478)	14.1 ± 1.6	11.6	12.1	13.0	14.0	15.1	16.2	16.9	10	<3	30	<3
14-18 (n = 578)	13.5 ± 2.0	10.4	11.0	12.1	13.3	14.7	16.1	17.0	10	3.0	30	<3
19-30 (n = 399)	14.3 ± 2.8	10.2	11.0	12.4	14.0	15.9	18.0	19.4	10	4.3	35	<3
31-50 (n = 618)	14.8 ± 2.7	10.8	11.6	12.9	14.6	16.4	18.2	19.4	10	<3	35	<3
51-70 (n = 618)	15.7 ± 2.8	11.5	12.3	13.8	15.5	17.4	19.3	20.6	10	<3	35	<3
71+ (n = 419)	15.7 ± 2.1	12.5	13.1	14.3	15.6	17.1	18.5	19.4	10	<3	35	<3

¹ Data from individuals with two days of reliable intake from NHANES 2003-2004. Results generated using SIDE program.

female age groups consumed inadequate protein. There is a trend for decreased protein intake as Americans age (Figures 2 and 3), although percentage of calories from protein increases slightly in older Americans. Given the rising concern about sarcopenia, protein intake in older Americans deserves increased attention.

MyPyramid food patterns have been estimated to provide a protein intake ranging from 17% to 21% of calories (5), but very few Americans are consuming this amount of protein. Given the positive benefits of higher protein intake on satiety and other physiologic functions, efforts should be undertaken to help Americans consume the recommended amounts of protein. Furthermore, given the prevalence of being overweight or obese in America and the role protein may play in managing body weight, it makes sense to consider increasing protein intake recommendations even further, to 25-30% of calories, a level that is still within the AMDR. Virtually none of the population approaches the highest AMDR for protein of 35% of calories.

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