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Published in final edited form as:
J Am Diet Assoc. 2011 May ; 111(5): 687–695. doi:10.1016/j.jada.2011.02.014.

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Abstract

Background—Adequate lifelong calcium intake is essential in optimizing bone health. Recent National Health and Nutrition Examination Survey data were used to quantify variation in calcium intake across adult age groups and to relate age-associated changes in calcium intake with energy intake. Additional goals were to assess differences in dietary calcium intake between supplemental calcium users and nonusers and to evaluate associations between age and calcium density in the diet.

Design—This cross-sectional analysis determined calcium and energy intake for National Health and Nutrition Examination Survey respondents during 2003–2006. Diet was assessed with 24-hour recall and supplement use via questionnaire. Trends in median intakes for dietary calcium, total calcium, and energy across age categories were assessed using survey analysis methods. Nutrient density was represented using calcium to energy intake ratios.

Results—The analyses included data from 9,475 adults. When compared to the 19- to 30-year age group, median dietary calcium intake was lower in the ≥81-year age group by 23% in men ($P<0.001$) and by 14% in women ($P=0.003$). These reductions coincided with 35% and 28% decreases, respectively, in median energy intake ($P<0.001$ for each sex). In contrast, the frequency of calcium supplement use increased ($P<0.001$) with age in both men and women. Yet, among female supplement users, the decline in median dietary calcium intake was greater than in nonusers ($P=0.02$). Calcium density in the diet significantly increased relative to age in men and women ($P<0.001$ for each sex); however, dietary and total calcium to energy ratios were insufficient to meet target ratios inferred by adequate intake standards after age 50 years.

Conclusions—Although supplemental calcium use and calcium density were highest in older age groups, they were not sufficient in meeting recommended levels. New approaches to increasing the frequency and level of calcium supplement use to enhance calcium density in diets may be necessary to reduce osteoporosis risk among older Americans.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST: No potential conflict of interest was reported by the authors.

Fractures are the 12th leading cause of disability in the United States, affecting 969,000 noninstitutionalized adults older than age 18 years in 2005 (1). It is known that multiple nutritional factors, such as vitamin D and calcium, play a key role in bone health (2,3). The Institute of Medicine has defined the Adequate Intake (AI) of calcium as 1,000 mg/day for individuals aged 19 to 50 years and 1,200 mg/day for persons older than age 51 years (4). A recent study evaluating dietary calcium and vitamin D intake using data from the 2003–2006 National Health and Nutrition Examination Survey (NHANES) (5) found that only 15% of men and 8% of women older than age 71 years had dietary calcium intakes meeting AI levels. Other reports from previous NHANES cycles showed that men on average met their AI level for calcium from ages 20 to 29 years, but fell short after age 40 years (6). On average women older than age 20 years did not meet their AI level (5,6).

Because dietary calcium intake is often inadequate, supplemental calcium potentially plays a key role in addressing this nutritional deficiency and in preventing the associated bone loss, particularly in older adults (7–9). Supplemental calcium includes calcium added to foods and calcium contained in dietary supplements and antacids. Although there has been an increase in milk and dairy consumption by US adults during the past decade (10), individuals are still turning to supplemental sources of calcium to meet AI levels (5). A meta-analysis summarizing controlled trials (11) suggests that calcium supplementation is important and may help to increase bone mineral density.

Despite the use of supplements, studies on total calcium intake (from both food and supplements) find that, among adults aged 31 to 50 years (from NHANES years 2003–2006), more than one third had total calcium intakes less than the recommended AI level. In the older age groups (above age 51 years), approximately two thirds were not meeting AI levels for calcium intake (5). Approximately half of adult men and women are taking some type of supplemental calcium (5,12–16). This latter finding suggests that failure to accurately account for supplemental calcium sources could potentially result in a serious underestimation of total calcium intake.

Assessing total calcium intake across the lifespan is important because higher lifetime calcium intake is associated with improved bone mass (17–19). Maintaining adequate calcium intake is complicated by the fact that energy intake declines with age (20,21). Therefore, if there is no change in the density of calcium in the diet, there will be a concomitant decline in calcium intake. A tool such as the Nutrient-Rich Food Index (22,23) can aid consumers in choosing nutrient-dense foods to meet nutrient requirements in light of the decline in energy intake typically associated with aging.

The goals of this study were to assess calcium intake from both dietary sources and supplements across adult age groups in the United States using the most recent available NHANES data. In addition, the objectives were to relate variation in calcium intake to age-related changes in energy intake and to examine how the concentration of calcium in the diet (as expressed by calcium per unit of energy intake) differs from the youngest to oldest age groups.

METHODS

Sample Population and Data Collection

NHANES is the only national survey that collects extensive health information from both face-to-face interviews and medical examinations. The data provide a cross-sectional picture of health and nutrition in the US population. The survey uses a complex, stratified, multistage, probability-cluster sampling design. A detailed description of the NHANES plans and procedures is provided elsewhere (24,25).

The National Center for Health Statistics presently conducts NHANES in biennial cycles. The analyses reported here utilized data from the 2003–2004 and 2005– 2006 cycles. Because the objective was to describe calcium intake relative to age among US adults, only NHANES participants aged 19 years and older were included in the study sample. Written informed consent was obtained from all participants or proxies, and the survey protocol was approved by the Research Ethics Review Board of the National Center for Health Statistics.

Dietary Interview and Analysis

The objective of the dietary interview component was to recall all types of foods eaten and amounts consumed in a 24-hour period. The dietary interview was conducted in person at a mobile examination center. All interviewers completed an intensive 1-week training course and were monitored during the interview process. Data were collected by NHANES interviewers using a US Department of Agriculture dietary data collection instrument, the Automated Multiple Pass Method (26). This method uses a five-step procedure to quantify 24-hour food intake (27,28). The US Department of Agriculture's Food and Nutrient Database for Dietary Studies, version 2.0, was used for estimating calcium and energy intake from the 2003–2004 data. Version 3.0 was used with the 2005–2006 data. In our study, only data on survey participants with dietary recall status codes of "reliable" were used. A code of reliable indicates that there were no missing reference values for any nutrient based on food items cited in the 24-hour recall.

The NHANES 2003–2006 oversampled low-income persons, adolescents aged 12 to 19 years, persons aged ≥60 years, African Americans, and Mexican Americans. To account for this, sampling weights are provided to support estimation of unbiased summary statistics for the US population. Sampling weights specifically related to the subsample of survey participants who completed the 24-hour dietary recall were used in all analyses.

Estimating Calcium Intake

Dietary calcium (in milligrams per day) was directly reported in the NHANES database as an estimate of intake on the day before the 24-hour recall was performed. Supplemental sources of calcium were reported indirectly based on responses to a questionnaire about the use of nutritional supplements. Supplements included singleand multi-ingredient nonprescription supplements, antacids, and prescription supplements. To calculate calcium intake from supplements, it was necessary to identify the quantities of elemental calcium in all calcium-containing supplemental ingredients and combinations of supplemental ingredients consumed by survey participants.

The NHANES database for nutritional supplements includes five ingredients that contain elemental calcium: elemental calcium itself, calcium carbonate (40% elemental calcium), coral calcium (33% elemental calcium), calcium L-threonate (12.9% elemental calcium), and calcium pentothenate (8.4% elemental calcium). All multi-ingredient supplements in the database that captured calcium in one of the five forms above were included. For example, calcium citrate is classified as a multi-ingredient supplement containing elemental calcium. Therefore, a participant's supplemental calcium intake from calcium citrate was captured by first determining the dose of calcium citrate consumed and then identifying the amount of elemental calcium in that dose.

Supplement users were defined as respondents receiving calcium from a supplemental source during the past month. For such individuals, an average daily intake of elemental calcium was determined for each supplement by the following formula: (days taken in past 30 days/30 days) × (servings per day) × (dosage per serving) × (calcium per dose). The total intake of supplemental calcium consumed per day was calculated by summing elemental calcium across all supplements. Among supplement users, daily dietary calcium intake and average daily supplemental calcium intake were added together to obtain an estimate for total calcium consumed.

Statistical Analysis

Data were separated by sex for all analyses. Base 10 logarithmic transformations were used to correct for skewness in the distributions of calcium and energy intake. Mean values of the transformed variables, adjusted for sampling weights and for sample stratification and clustering, were calculated using Stata (version 10.1, 2007, Stata Corp, College Station, TX). Antilog transformations of means provided estimates for median intakes of dietary calcium, total calcium, and energy (29). For a measurement with a skewed distribution, the median provides an assessment of central tendency (the 50th percentile) with a less ambiguous interpretation than the mean. The delta method was used to transform standard errors for means on the logarithmic scale to those for medians on the original scale (30).

Statistical tests for trends in median calcium and energy intake across age categories and for differences in intake between supplement users and nonusers were conducted by linear regression. Tests for trends in the frequency of supplement use were performed by logistic regression. Comparisons of trends between supplement users and nonusers were performed by including interaction terms in the regression analyses. All tests included adjustment for survey design factors. Statistical significance was defined using a 0.05 threshold. To relate median dietary calcium to energy ratios to target ratios, 95% confidence intervals were calculated and compared within each age group.

The 2005 Dietary Guidelines for Americans suggest that consumption of an energy-dense, nutrient-poor diet may limit a person’s ability to achieve recommended nutrient intakes (31). To assess density of calcium within the diet, dietary calcium to energy ratios (in milligrams per kilocalorie) were calculated by dividing the dietary calcium intake for each individual by their daily energy intake. The ratio was then log transformed, and a mean on the log-scale was determined using survey weights. This value was then back transformed to provide an estimated median for dietary calcium to energy ratios. This method was repeated for total calcium intake to arrive at a total calcium to energy ratio for each participant. Also, a target ratio was calculated, defined as the optimal ratio of calcium to energy intake (milligrams per kilocalories per day) to be consumed to achieve the daily calcium AI, by dividing each individual’s appropriate calcium AI level by their daily energy intake. Using the youngest age group as the reference group, percent changes in calcium intake, energy intake, and calcium to energy ratio were calculated for all other age groups.

RESULTS

Participant characteristics are shown in Table 1. The total number of participants included in the analyses was 9,475. Median calcium intakes are presented in Table 2. Median dietary calcium intake in men decreased by 22.7% from the youngest to the oldest age group, from 942 mg/day to 728 mg/day ($P<0.001$). In women, it decreased by 14.1% (686 mg/day to 589 mg/day) from the youngest to oldest age group ($P=0.003$).

After age 30 years, energy intake for both men and women was consistently lower in each older age group than in the adjacent younger age group (Table 2). Men’s median energy intake declined by 35% from the 19- to 30-year age group to the ≥81-year age group, from 2,668 kcal/day to 1,733 kcal/day ($P<0.001$). For women, median energy intake showed a 28% reduction from the youngest to oldest age group, from 1,844 kcal/day to 1,325 kcal/day ($P<0.001$).

To represent the influence of age-related reductions in energy intake on calcium nutrition, dietary calcium to energy ratios (milligrams per kilocalorie) were calculated for both sexes. As shown in Table 2, the median dietary calcium to energy ratio for men was 19% higher in the ≥81-year age group than in the 19- to 30-year age group (P=0.001), and for women it was 20% higher in the ≥81-year age group than in the 19- to 30-year age group (P<0.001).

Median target calcium to energy ratios were calculated to illustrate the typical intake of calcium required to meet the AI level for individuals within each age group and are also included in Table 2. They show, for example, that a typical woman older than age 81 years would need to ingest 0.91 mg of calcium for every 1 kcal of energy consumed to meet the calcium AI. Among women, the 95% confidence interval for the median dietary ratio did not overlap with the interval for the median target ratio in any age group (data not shown). For men, intervals did overlap in the two youngest age groups, but not in any age group older than 41 years.

We found that 50.8%±0.9% of all individuals ≥19 y of age were taking a calcium supplement. The percentage of individuals taking a calcium supplement increased in men from 33.5% in the 19- to 30-year age group to 53.9% in the ≥81-year age group (P<0.001). In women, these percentages rose from 42.1% to 63.6% across the range of age groups (P<0.001) (Table 3).

Patterns of calcium intake stratified by supplement use are shown in Tables 4 and 5. Surprisingly, in both men and women, after adjusting for age, median dietary calcium intake in supplement users was significantly higher than in supplement nonusers (P=0.005 in men, P<0.001 in women). In men, supplement users and nonusers had similar (P=0.64) age-related declines in dietary calcium intake—a 24% decrease among supplement users from the youngest to the oldest age group (P<0.001) and a 23% decrease among nonusers (P<0.001) (Tables 4 and 5). In women, dietary calcium intake significantly decreased (P<0.001) in supplement users (28% from the youngest to the oldest age group) (Table 5) but not (P=0.33) in supplement nonusers (5% from the youngest to oldest age group) (Table 4). The age-related trends in dietary calcium were significantly different (P<0.019) between female supplement users and nonusers. Supplemental calcium intake among supplement users increased with age in both men and women, by 163 mg/day from the youngest to oldest age group in men (P<0.001) and by 204 mg/day from the youngest to oldest age group in women (P<0.001) (Table 5).

Calcium to energy ratios, stratified by supplement use, are also presented in Tables 4 and 5. Median dietary calcium to energy ratios among nonusers were higher in the ≥81-year age group than in the 19- to 30-year age group in both sexes, specifically 21% greater in men (P=0.04) and 33% greater in women (P<0.001). In contrast, among supplement users, median total calcium to energy ratios (based on the sum of dietary and supplemental calcium) were 49% greater in the ≥81-year age group among men (P<0.001) and 47% greater in the ≥81-year age group among women (P<0.001). The age-related trends in dietary and total calcium to energy ratios for supplement nonusers and users, respectively, were significantly different for both men (P=0.004) and women (P=0.004).

The Figure depicts percentage increases in median calcium to energy ratios across age groups, stratified by sex and supplement use, using the 19- to 30-year age group as a reference. If the changes across age groups represent age-related changes within individuals, the Figure shows how the density of calcium in the diet would have to change with age to meet AI levels. Supplement use enhances total calcium to energy ratios after age 40 years and closes the gap between dietary calcium intake and target intake, particularly in female supplement users. Yet supplement use does not increase the calcium intake sufficiently to allow the median total calcium to energy ratio to reach the target ratio in any over-50-years age group for either sex. However, after age 50 years, women supplement users come closer to achieving target ratios than men. For supplement nonusers, the Figure shows that percent change in the dietary calcium to energy ratio steadily increases after age 50 years, but does not approach the trend for percent change in the target ratio after that age.

DISCUSSION

Many studies present data describing calcium intake in the US population. Among them, this study is unique in that calcium intake from both dietary and supplemental sources were evaluated across adult age groups and compared to concomitant patterns of energy intake. In relating calcium and energy intake, calcium density within the diet was assessed and highlighted the fact that calcium density, as well as supplementation, plays a critical role in attainment of established AI levels.

Our data suggest that, in general, American adults may experience an age-related decline in calcium intake explained, in part, by a concurrent decline in energy intake. During the survey period, half of US adults were taking a calcium supplement and the frequency of supplement use increased with age. Although levels of dietary intake of calcium from food sources decreased with age, levels of supplemental intake increased across the lifespan. The age-related increase in the frequency and levels of supplemental intake counteracts, in part, the decline in dietary calcium and energy intake, but does not appear to produce sufficient calcium density to support achievement of AI.

Studies of calcium intake utilizing NHANES data have reported findings similar to ours in terms of dietary calcium intake and the frequency of supplement use. Using NHANES data from 1999–2000, Ervin and colleagues (6) found median dietary calcium intake in men to be 856 mg/day in the 20- to 39-years age group, 834 mg/day in the 40- to 59-years age group, and 716 mg/day in the >60 years age group. Women's median dietary calcium intakes were 684 mg/day, 621 mg/day, and 563 mg/day, respectively, by age group.

Ma and colleagues (32) utilized NHANES data from the period 1999–2002 and evaluated calcium intake for men and women aged ≥19 years, stratified by osteoporosis risk. Survey participants had an average daily calcium intake from both diet and supplements of 944 mg in the high-risk group, 821 mg in the moderate-risk group, and 846 mg in the low-risk group. Approximately 48% of the population reported taking a calcium supplement. Stafford and colleagues (33) estimated average calcium intake using NHANES data from the period of 1999–2002 and also data from the National Disease and Therapeutic Index over the period 1994–2004. Only individuals with osteoporosis were evaluated. Overall, 64% of both men and women reported using a calcium containing supplement. Median calcium intake for supplement nonusers was 433 mg/day, and 1,319 mg/day for supplement users.

Ervin and Kennedy-Stephenson (12), using the NHANES 1988–1994 dataset, found that 42% of men and 54% of women were taking a calcium supplement. More recently, Bailey and colleagues (5) found 43% of the US population older than age 1 year to be taking a calcium-containing supplement. The percentage of calcium supplement users increased to 62% among those ≥71 years.

Reports of dietary calcium intake using data from sources other than NHANES provide variable findings. An 18-year prospective analysis in 72,337 postmenopausal women found average dietary calcium intake, measured by food frequency questionnaires, to be 730 mg/day (34). In our study, women older than age 51 years had a median dietary calcium intake of 636 mg/day. The National Osteoporosis Risk Assessment study used a mailed food frequency questionnaire to retrospectively estimate calcium intake in childhood, adolescence, and adulthood in 76,507 postmenopausal women. Across all adult age groups, average dietary calcium intake was 600 mg/day (17). When supplements were included in the National Osteoporosis Risk Assessment analysis, average daily calcium intake increased to 900 mg/day in postmenopausal women, a value consistent with our own results. Data gathered from Food and Agriculture Organization food balance sheets and from published studies between January 1980 and January 2007 estimated the average daily intake of dietary calcium to be 962 mg in US men and 756 mg in US women >18 years old (35). These estimates are higher than the median dietary intake levels observed in our study for persons aged >19 years (856 mg for men and 670 mg for women). Differences in estimates between our study and studies based on non-NHANES sources may be related to sampling from different populations, use of disparate statistical estimators (mean vs median), the skewed distribution of calcium intake at the population level, and/or that food balance sheets tend to overestimate nutrient intake (36).

Calcium supplement users were found to have higher intakes of dietary calcium than nonusers. This finding is consistent with the work of Ervin and Kennedy-Stephen-son (12). Using the NHANES 1988–1994 dataset, they found that in individuals aged ≥60 years, median calcium intake among supplement users was higher (819 mg/day in men and 747 mg/day in women) than among those not taking supplements (690 mg/day in men and 523 mg/day in women) (12). Research suggests that individuals who use supplements are more likely to be women, white, well educated, to live on the West coast, to have higher income, and to be older than age 60 years (37,38). Also, several studies have suggested that supplement users are more health conscious (39,40) and tend to eat a more nutritious diet (41–44).

Our study further explored these patterns by examining dietary calcium intake and supplement use across the lifespan. Female supplement users had a higher intake of calcium from foods than female supplement nonusers. Among female users, median dietary intake of calcium steadily decreased from the youngest age group to the oldest. In contrast, among female nonusers dietary intake remained relatively constant across age groups. It is not known whether age-related changes in diet precede greater reliance on supplements or vice versa. Perhaps an aversion to dairy products (whether related to ethnic dietary patterns, biological intolerances, or distaste) leads to a recognition of the need for increased supplement use over time. Or, perhaps a sense of security created by taking a calcium supplement gradually results in less attention to dietary sources of calcium. These speculations highlight the need for future research to investigate the rationales behind the decision to use calcium supplements and the differential changes in dietary calcium intake between supplement users and nonusers.

Nutrient density is a concept that has gained considerable attention recently and focuses on the ratio of key nutrients to total energy (23). Therefore, it is important to view calcium intake relative to the natural decline in energy intake that accompanies aging. Calcium to energy ratios were used in our study to highlight the importance of calcium density in the diet. The data underscore the fact that the decline in dietary calcium intake across age groups occurs in the context of a general reduction in energy intake. Although the use of supplemental calcium closes the gap between the dietary calcium to energy ratio and the target ratio, a deficit still exists. These findings emphasize the importance of nutrient density in the diet.

One methodologic limitation of this study is its use of a single 24-hour recall to assess nutrient intake. Potential sources of error in such self-reported intake data include omission (or inclusion) of foods frequently eaten (or not eaten) on other days, over- or under-reporting of portion sizes, and inaccuracies in tables of food composition (45–47). In addition, reliance on recall for a single day precludes the possibility of estimating usual intake. The Automated Multiple Pass Method of dietary recall currently used by NHANES provides valid summary statistics for total energy and nutrient intake at the group level (27). This information should be adequate to establish the existence of strong patterns in such statistics across age groups for calcium and energy intake and for calcium density in the diet.

It is important to note that, because the NHANES survey uses a cross-sectional design, its data cannot be used to characterize directly changes in calcium and energy intake relative to aging within individuals. Instead, our research primarily assessed differences in median daily calcium and energy intake between subpopulations representing different age groups. If those differences do not reflect potential secular or generational trends, they may, in fact, capture changes experienced by many persons.

Our study’s use of existing data may lead to underestimation of calcium intake. One source of underestimation may be the US Department of Agriculture’s method for obtaining 24-hour dietary recall. When name-brand food items cannot be recalled and nonbrand food items are recorded in their place, the calcium found in calciumfortified and calciumenriched name brand products may be missing from recorded intakes. Another source of underestimation may arise from the limited detail that NHANES data include concerning the composition of dietary supplements. The NHANES supplement data files do not provide estimated ingredient amounts when a dietary supplement includes an ingredient that is, in turn, a blend of other ingredients. For purposes of this study, such blended ingredients were excluded from the determination of supplemental calcium intake. This procedure is likely to result in minor underestimation of total calcium intake from supplemental sources.

CONCLUSIONS

Calcium plays a fundamental role in promoting bone health and forestalling osteoporosis. In light of evidence that energy intake declines with aging, calcium-dense foods and calcium supplements become vital factors in maintaining adequate calcium intake across the lifespan. Encouraging calcium supplementation is an established approach to addressing this issue in the clinical setting— one that needs additional emphasis to promote more frequent and sufficient supplementation in meeting AI levels. Altering the concentration of calcium in the diet relative to energy by increasing consumption of nutrientdense foods is a new and important concept that also deserves additional consideration as a component of osteoporosis prevention.

Acknowledgments

FUNDING/SUPPORT: This research was funded by a grant from the Donaghue Foundation Nutrition Research Competition within the University of Connecticut. Funding for this program was provided by the Patrick and Catherine Weldon Donaghue Medical Research Foundation. Support for data management and analysis was provided by the Lowell P. Weicker Jr, General Clinical Research Center at the University of Connecticut Health Center (NIH/NCRR M01 RR06192).

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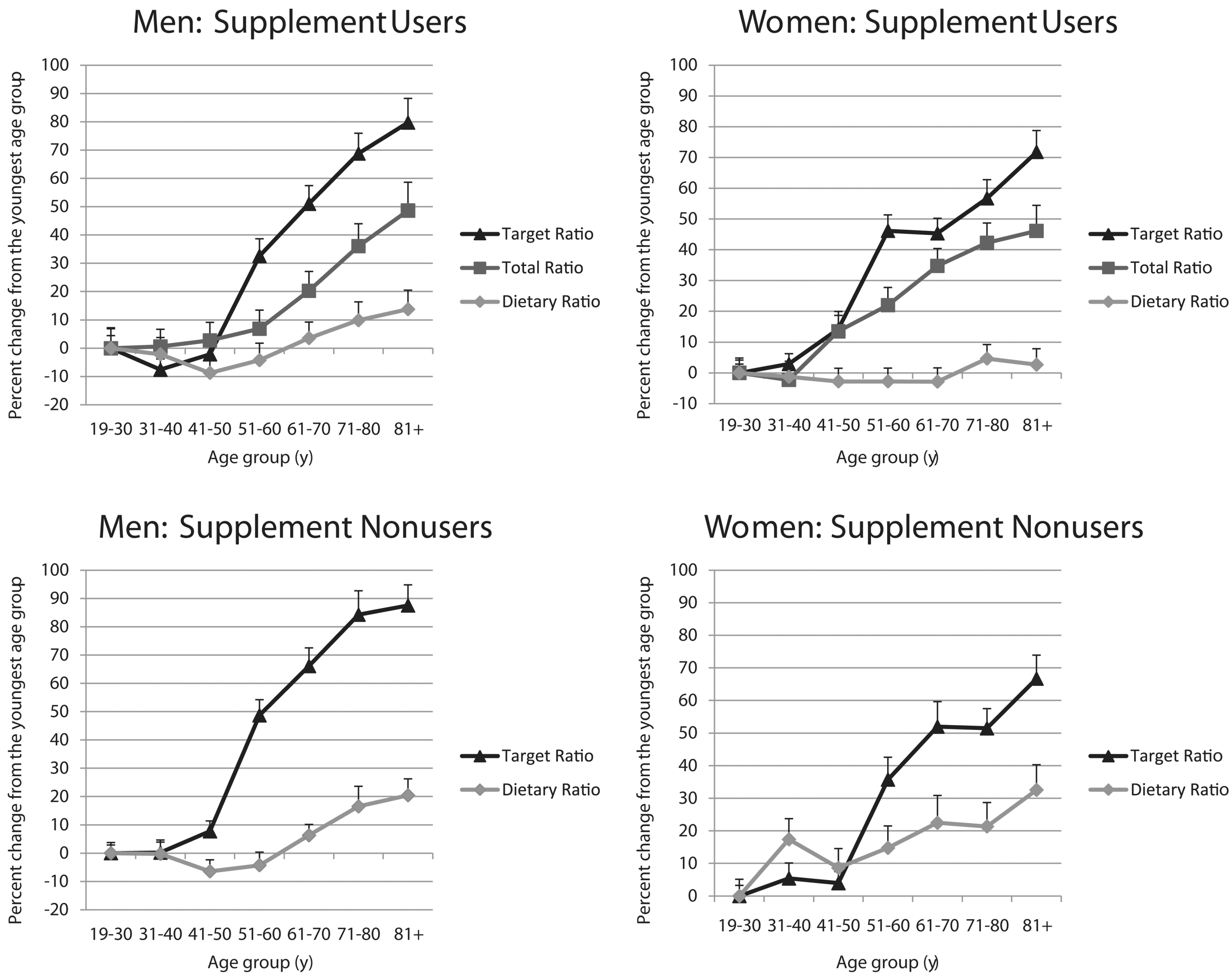

Figure.

Percent change in median calcium to energy ratios across age groups by sex and supplement use, National Health and Nutrition Examination Survey 2003–2006. The dietary calcium ratio (milligrams/kilocalorie) compares daily dietary calcium intake to daily energy intake at the individual level. The total calcium ratio (milligrams/kilocalorie) compares daily total calcium intake (from both dietary and supplemental sources) to daily energy intake at the individual level. The target ratio is defined as the optimal ratio of calcium to energy intake, based on an individual's current daily energy intake level that needs to be consumed to achieve the recommended daily calcium adequate intake level. For each measure, percent changes were calculated by comparing medians in all age groups to the median value in the 19- to 30-year age group. NOTE: Information from this figure is available online at www.adajournal.org as part of a PowerPoint presentation.

Table 1

Sample of eligible participants (n=9,475) from the National Health and Nutrition Examination Survey, 2003–2006, and estimated population percentages, stratified by sex and age

Age (y)	n	%±Standard error[a]
Men		
19–30	1,097	11.4±0.65
31–40	706	9.1 ±0.49
41–50	730	9.6±0.47
51–60	562	8.1 ±0.45
61–70	650	5.4±0.31
71–80	515	3.2±0.21
≥81	292	1.4±0.13
Women		
19–30	1,367	11.3±0.49
31–40	794	9.8±0.58
41–50	728	9.7±0.49
51–60	602	8.6±0.43
61–70	648	6.2±0.33
71–80	448	4.1 ±0.25
≥81	336	2.2±0.19

[a]%±standard error represents the estimate of the entire US population.

NOTE: Information from this table is available online at www.adajournal.org as part of a PowerPoint presentation.

Table 2

Median daily calcium intake from dietary sources, energy intake, dietary calcium to energy ratio, and target calcium to energy ratio among US adults by sex and age group, National Health and Nutrition Examination Survey 2003–2006

Age group (y)	Dietary calcium (mg)	Energy intake (kcal)	Dietary calcium to energy ratio (mg/kcal)	Target calcium to energy ratio[a] (mg/kcal)
		median± standard error		
Men				
19–30	942±27.9	2,668±48.3	0.35±0.008	0.37±0.007
31–40	968±28.2	2,747±43.0	0.35±0.009	0.36±0.006
41–50	852±23.9	2,577±39.1	0.33±0.008	0.39±0.006
51–60	777±25.3	2,265±47.8	0.34±0.008	0.53±0.011
61–70	758±25.3	2,011 ±49.9	0.38±0.006	0.60±0.015
71–80	735±25.7	1,809±36.9	0.41 ±0.013	0.66±0.014
≥81	728±26.4	1,733±37.1	0.42±0.009	0.69±0.015
Women				
19–30	686±24.9	1,844±38.9	0.37±0.009	0.54±0.011
31–40	730±20.4	1,782±29.9	0.41 ±0.011	0.56±0.009
41–50	671 ±19.4	1,701 ±33.4	0.39±0.009	0.59±0.012
51–60	646±26.0	1,583±41.4	0.41 ±0.012	0.75±0.020
61–70	641 ±23.1	1,535±34.1	0.42±0.012	0.75±0.017
71–80	633±19.6	1,454±29.2	0.44±0.012	0.78±0.017
≥81	589±24.3	1,325±33.3	0.44±0.014	0.91 ±0.023

[a]Concentration of calcium per kcal of energy required to meet established Adequate Intake guidelines (4).

NOTE: Information from this table is available online at www.adajournal.org as part of a PowerPoint presentation.

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Table 3

Number and estimated percentage of US adults using dietary supplements containing calcium, by age and sex, National Health and Nutrition Examination Survey, 2003–2006

	Using Calcium Supplements	
Age group (y)	**n**	**%±Standard error**
Men		
19–30	285	33.5±2.77
31–40	251	43.0±2.68
41–50	305	47.0±2.34
61–70	292	52.8±3.04
71–80	259	56.4±3.65
≥81	148	53.9±2.38
Women		
19–30	568	42.1 ±2.24
31–40	386	50.3±2.43
41–50	342	56.4±2.62
51–60	358	65.8±1.80
61–70	388	69.5±1.89
71–80	278	63.5±2.92
≥81	214	63.6±2.50

Table 4

Median daily calcium intake from dietary sources, energy intake, and dietary calcium to energy ratio among US adults who did not use a calcium supplement, by sex and age group, National Health and Nutrition Examination Survey 2003–2006

Age group (y)	Dietary calcium (mg)	Energy intake (kcal/d)	Dietary calcium to energy ratio (mg/kcal)
		median± standard error	
Men			
19–30	928±39.8	2,702±75.6	0.34±0.009
31–40	923±46.7	2,697±69.2	0.34±0.014
41–50	806±31.6	2,508±51.3	0.32±0.011
51–60	716±31.0	2,180±56.1	0.33±0.013
61–70	712±27.5	1,952±53.6	0.36±0.009
71–80	704±33.3	1,759±62.8	0.40±0.022
≥81	715±38.9	1,729±46.7	0.41 ±0.016
Women			
19–30	592±30.2	1,783±55.2	0.33±0.011
31–40	659±28.6	1,691 ±57.0	0.39±0.016
41–50	619±26.6	1,715±33.6	0.36±0.014
51–60	601 ±32.0	1,576±65.9	0.38±0.017
61–70	572±41.3	1,408±59.9	0.41 ±0.024
71–80	569±27.0	1,412±38.0	0.40±0.019
≥81	565±30.7	1,283±40.2	0.44±0.020

Table 5

Median daily calcium intake from dietary sources, calcium intake from supplements, energy intake, dietary calcium to energy ratio, and total calcium to energy ratio among US adults who used a calcium supplement, by sex and age group, National Health and Nutrition Examination Survey 2003–2006

Age group (y)	Dietary calcium (mg)	Supplemental calcium (mg/d)	Energy intake (kcal/d)	Dietary calcium to energy ratio (mg/kcal)	Total[a] calcium to energy ratio (mg/kcal)
		median± standard error			
Men					
19–30	973±57.3	74±7.1	2,600±78.0	0.37±0.018	0.43±0.022
31–40	1030±45.6	106±9.7	2,813±69.8	0.37±0.013	0.43±0.014
41–50	908±40.4	136±13.3	2,657±74.0	0.34±0.011	0.44±0.015
51–60	843±35.9	141 ±10.4	2,353±77.5	0.36±0.014	0.46±0.016
61–70	801 ±32.9	162±16.0	2,066±58.8	0.39±0.009	0.52±0.013
71–80	760±33.7	190±13.2	1,849±51.4	0.41 ±0.013	0.59±0.016
≥81	739±36.1	236±22.7	1,736±61.3	0.43±0.014	0.64±0.028
Women					
19–30	840±41.3	169±14.8	1,932±50.0	0.44±0.015	0.58±0.017
31–40	806±28.8	143±16.8	1,877±38.7	0.43±0.017	0.57±0.024
41–50	700±22.0	213±23.1	1,691 ±49.0	0.42±0.012	0.66±0.032
51–60	671 ±29.0	280±23.9	1,586±40.5	0.42±0.012	0.71 ±0.026
61–70	674±22.3	391 ±24.0	1,595±37.3	0.42±0.013	0.78±0.022
71–80	673±30.9	380±33.1	1,479±43.3	0.46±0.013	0.83±0.030
≥81	603±33.0	373±35.4	1,349±44.2	0.45±0.017	0.85±0.041

[a] Total includes calcium from dietary and supplemental sources.