

Determining attitudinal and behavioral factors concerning milk and dairy intake and their association with calcium intake in college students

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BACKGROUND/OBJECTIVES: Average intake of calcium among college students is below the recommended intake, and knowledge surrounding the attitudinal and behavioral factors that influence milk and dairy intake, a primary food source of calcium, is limited. The purpose of this study was to evaluate college students' attitudes and behaviors concerning milk and dairy consumption and their association with calcium intake.

SUBJECTS/METHODS: Participants were 1,730 undergraduate students who completed an online survey (SurveyMonkey) as part of baseline data collection for a social marketing dairy campaign. The online survey assessed attitudes and behaviors concerning milk and dairy intake, and calcium intake. Questions about milk- and dairy-related attitudes and behaviors were grouped into 14 factors using factor analysis. Predictors of calcium intake were then evaluated.

RESULTS: Median calcium intake across all participants was 928.6 mg/day, with males consuming higher calcium intakes than females ($P < 0.001$). Adjusted for gender, calcium intakes were most strongly (and positively) correlated with associating milk with specific eating occasions and availability (i.e., storing calcium-rich foods in one's dorm or apartment) (both $P < 0.001$). Other correlates of calcium intake included: positive-viewing milk as healthy ($P = 0.039$), having family members who drink milk ($P = 0.039$), and taking calcium supplements ($P = 0.056$); and negative-parent rules concerning milk ($P = 0.031$) and viewing milk in dining halls negatively ($P = 0.05$).

CONCLUSIONS: Calcium intakes among college students enrolled in the current study was below the recommended dietary allowance of 1,000 mg/day, reinforcing the need for dietary interventions in this target population, especially females. Practitioners and researchers should consider the factors found here to impact calcium intake, particularly associating milk with specific eating occasions (e.g., milk with breakfast) and having calcium-rich foods available in the dorm room or apartment, as intervention strategies in future efforts aimed at promoting milk and dairy foods and beverages for improved calcium intake in college students.

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INTRODUCTION

Achieving an adequate intake of calcium during adolescence and young adulthood is essential for attaining peak bone mass and reducing osteoporotic fracture risk later in life [1,2], and may also contribute to the maintenance of a healthy weight and prevention of other chronic diseases (e.g., hypertension, obesity, and certain cancers) [3-5]. Of concern, only 37.6% of women and 42.8% of men in the U.S. between 19 and 50 years of age meet the recommended dietary allowance (RDA) of 1,000 mg of daily calcium intake [6]. The percentage of women and men not meeting the RDA for calcium is even higher in young adults, 68% and 53% for females and males, respectively [7].

There is an overall decrease in diet quality during the transition from adolescence to young adulthood, which includes a reduced calcium intake [7-9]. In the specific young adult population of college students, average calcium intakes range from 820 to 1,052 mg/day, consistently falling below the RDA for calcium [7,10,11]. Unfortunately, the negative dietary habits that fuel this negative trend may persist into later adulthood, potentially leading to adverse effects on long-term health [12]. Contributors to the overall poor dietary intakes of college students include changes in personal (e.g., attitude that healthy eating is inconvenient) and external (e.g., reduced availability of healthy foods) behavioral factors, however, there is limited knowledge with specific regards to dietary calcium [13-15].

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According to the social cognitive theory (SCT), behavior is determined by a reciprocal relationship between personal (e.g., attitudes) and environmental (e.g., availability and social norms) factors [16]. Several investigations have explored behavioral determinants of calcium intake related to SCT principles in adolescents [7,17-21] and found that calcium intakes are influenced by taste preference for milk [19], health attitudes [19], availability of milk at meals [7,19,20], associating milk with breakfast [17], and familial influence (i.e., parental intakes) [20]. However, limited studies have examined whether similar factors influence calcium intake in college students [22,23].

Given the persisting public health problem of low calcium intakes in college students, there is a critical need to identify the factors influencing milk and dairy intake, a primary source of calcium, in this nutritionally vulnerable population. Guided by the SCT framework, the objective of this study was to evaluate attitudes and practices concerning milk and dairy consumption and their association with calcium intake in college students. A better understanding of factors that influence calcium intake may lead to intervention strategies that can improve calcium intakes and, ultimately, overall diet quality in college students.

SUBJECTS AND METHODS

Participants

An invitation to take part in an online survey was emailed to all undergraduate students at a large, public, Midwestern university in October 2014. A reminder email was sent after seven days. This invitation was part of baseline data collection for a campus-wide social marketing dairy campaign. Students completed the survey via SurveyMonkey and indicated their consent to participate by completing the survey. Participants had the option of providing their email address to be entered into a drawing for a \$50 gift card (1/755 odds of winning).

The university's Institutional Review Board approved study procedures via expedited review (IRB#: 2012B0061).

Survey methodology

Attitudes and behaviors regarding calcium consumption with an emphasis on milk and dairy products were assessed with a 69-item survey. Questions were adapted from a survey of motivators and barriers to consuming calcium-rich foods in early adolescents to fit an older, college student population (e.g., references to "home" were changed to "dorm room/apartment"). [18]. Answer choices were on a 5-point Likert scale with 1 being "strongly disagree" and 5 being "strongly agree". The survey assessed the following 14 constructs: food association/liking of milk (e.g., "I eat cereal with milk"); milk viewed as healthy (e.g., "I drink milk because it is good for me"); milk not beverage choice (e.g., "There are so many beverages to choose from that milk is usually my last choice"); dairy alternatives (e.g., "I like soy milk"); calcium-rich foods in dorm/apartment (e.g., "Most of the time there is yogurt in my dormitory or apartment"); flavored milk (e.g., "Flavored milk is the only kind of milk I like to drink"); family drinks milk (e.g., "Everyone in my family drinks milk every day"); parental rules concerning milk (e.g., "When I was living at home, my mother made me drink milk every

day"); eating occasion with milk (e.g., "I always have milk with breakfast"); milk in dining halls viewed negatively (e.g., "Milk from my dining hall tastes bad"); sugar-sweetened beverages/cost concerns with milk (e.g., "I buy soda pop because it is cheaper than milk"); calcium supplements (e.g., "Most days I take a calcium supplement"); milk viewed negatively (e.g., "Milk is not healthy"); and lactose intolerance/milk allergy (e.g., "I am allergic to milk"). A validated short calcium questionnaire which asks about the typical weekly consumption of 25 calcium-containing foods was used to determine calcium intake [24]. Demographic information including gender, race/ethnicity, age, and class rank was also collected.

Data analysis

Statistical analysis was performed in SPSS (v22). Participants with estimated calcium intakes < 100 mg/day or > 2,500 mg/day were considered outliers [25]. Mann Whitney U Test was used to assess gender differences in median calcium consumption and attitudes and behaviors. Factor analysis extracted with the maximum likelihood method with varimax rotation was used to reduce questions concerning attitudes and behaviors regarding calcium consumption to the aforementioned 14 factors with a Kaiser-Meyer-Olkin measure of sampling adequacy of 0.897. The number of factors retained was determined by scree plots of eigen values. Of the original 69 questions, 9 were not included as they were determined to be unrelated to the other questions and did not load well to the factors. Reliability was assessed for each factor with Cronbach's Alpha values ranging from 0.640-0.913. Responses on attitude and behavior questions were then averaged within these 14 factors. Multiple linear regression was used to model predictors of calcium intake. Results were considered significant at $P < 0.05$.

RESULTS

A total of 1,730 students completed the survey (3.9% response rate from the undergraduate population). Participants were primarily non-Hispanic Caucasian (78%) with more females (63.9%) than males, and fairly equally distributed across the four class ranks (Table 1). Relative to university demographics, a higher proportion of study participants were female (63.9% vs. 47.5% at university level), non-Hispanic White (78.1% vs. 71.7% at university level), and Asian/Pacific Islander (10.4% vs. 5.8% at university level).

Calcium intake

The median calcium intake for all students was 928.6 mg/day, with males consuming greater calcium intakes than females ($P < 0.001$) (Table 2). When examining individuals according to RDA life stage group [18 years (1,300 mg/day calcium) and 19 years and older (1,000 mg/day calcium)] [26], a high proportion of students fell short of recommendations. Compared to the respective RDA, 78.7% of females and 62.1% of males aged 18 years old and 60.0% of females and 45.4% of males aged 19 years and older failed to meet the recommendation. Within both life stage groups, males consumed significantly higher calcium intakes than females ($P < 0.01$ for 18 years old; $P < 0.001$ for 19 years and older).

Table 1. Demographic characteristics of participants

	N (%) ¹⁾
Race	
Caucasian	1,352 (78.2)
African American	59 (3.4)
Hispanic	76 (4.4)
Asian/pacific islander	180 (10.4)
Native American	3 (0.2)
Not reported	60 (3.4)
Gender	
Female	1,105 (63.9)
Male	625 (36.1)
Age (yrs)	
18	347 (20.0)
19-20	738 (42.7)
21-22	502 (29.0)
23-25	76 (4.4)
25 and older	67 (3.9)
Class rank	
Freshman	449 (25.9)
Sophomore	363 (21.0)
Junior	417 (24.1)
Senior	486 (28.1)
Not reported	15 (0.9)

¹⁾ Values represent number (N) of participants and percent of total (%)

Table 2. Median dietary calcium intakes in college students

	18 yrs ¹⁾		≥ 19 yrs ²⁾		All ages	
	N	Dietary calcium (mg/d) ^{3,4)}	N	Dietary calcium (mg/d) ^{3,4)}	N	Dietary calcium (mg/d) ^{3,4)}
Males	103	1,100.0	522	1,057.1	625	1,071.4
Females	244	885.7	861	885.7	1,105	885.7
Both males and females	347	928.6	1,383	928.6	1,730	928.6

N: number of participants

¹⁾ Recommended dietary allowance (RDA) for calcium for individuals 18 years old is 1,300 mg/day

²⁾ RDA for calcium for individuals ≥ 19 years old is 1,000 mg/day

³⁾ Values represent median

⁴⁾ Significant difference ($P < 0.01$) in dietary calcium intake between males and females determined by Mann-Whitney U Test

Table 3. Attitudes and behaviors concerning milk and dairy consumption

	Mean (SD) ^{1,2)}	Female (SD) ^{1,2)}	Male (SD) ^{1,2)}	P-value ³⁾
Food association/liking of milk	3.95 (0.76)	3.85 (0.79)	4.03 (0.70)	< 0.001
Milk viewed as healthy	3.50 (0.96)	3.46 (0.98)	3.53 (0.95)	0.12
Milk not beverage choice ⁴⁾	3.43 (0.88)	3.47 (0.92)	3.16 (0.91)	< 0.001
Dairy alternatives	3.26 (0.85)	3.33 (0.86)	3.15 (0.85)	< 0.001
Calcium-rich foods in dorm/apartment	3.18 (0.81)	3.35 (0.77)	3.14 (0.84)	< 0.001
Family drinks milk	2.60 (1.13)	2.47 (1.10)	2.67 (1.10)	< 0.001
Parental rules concerning milk	2.45 (1.20)	2.39 (1.20)	2.55 (1.20)	0.003
Milk with specific eating occasions	2.39 (0.90)	2.21 (0.91)	2.61 (0.95)	< 0.001
Milk in dining halls viewed negatively ⁴⁾	2.36 (0.92)	2.41 (0.92)	2.25 (0.91)	0.003
Sugar-sweetened beverages/cost concerns with milk ⁴⁾	2.16 (0.65)	2.09 (0.62)	2.24 (0.67)	< 0.001
Flavored milk	2.06 (1.00)	2.03 (1.00)	2.09 (0.96)	0.18
Milk viewed negatively ⁴⁾	2.05 (0.70)	2.06 (0.68)	2.01 (0.69)	0.12
Calcium supplements	1.82 (0.95)	1.90 (1.00)	1.62 (0.87)	< 0.001
Lactose intolerance/milk allergy ⁴⁾	1.70 (1.00)	1.82 (1.10)	1.53 (0.94)	< 0.001

¹⁾ Values represent mean (SD)

²⁾ Reported on a 5-point Likert scale with 1 being "strong disagree" and 5 being "strongly agree"

³⁾ Differences between males and females in attitudes and behaviors determined by Mann-Whitney U Test

⁴⁾ A lower mean score is more favorable

Attitudes and behaviors regarding milk and dairy

According to mean factor responses from the questionnaire (on a scale of 1 being strongly disagree to 5 being strongly agree), students most strongly agreed that they liked milk and associated consuming it with specific foods (e.g., cereal) (3.95 ± 0.76) and viewed milk as healthy (3.50 ± 0.96) (Table 3). Students most strongly disagreed that they had concerns with lactose intolerance and milk allergies (1.70 ± 1.00) and took calcium supplements (1.82 ± 0.95). Among these top ranking strongly agree and strongly disagree responses, there were gender differences in milk liking and association with specific foods (males scored higher), concerns with lactose intolerance and milk allergies (females scored higher), and taking calcium supplements (females scored higher).

Determinants of calcium intake

Adjusting for gender, 7 of the 14 survey factors were significantly associated with calcium intakes (Table 4). Associating milk with specific eating occasions, availability (i.e., having calcium rich foods in the dorm or apartment), viewing milk as healthy, having family members who drink milk, and taking calcium supplements positively associated with calcium intake, whereas having parental rules regarding milk and viewing milk in dining halls as negative were negatively associated with calcium intake.

Table 4. Factors significantly associated with calcium consumption in college students¹⁾

	Beta (SE) ²⁾	P-value
Milk with specific eating occasions	142.0 (21.2)	< 0.001
Calcium-rich foods in dorm/apartment	98.3 (17.6)	< 0.001
Milk viewed as healthy	37.4 (18.1)	0.034
Family drinks milk	30.4 (14.7)	0.039
Calcium supplements	31.4 (16.4)	0.056
Parental rules concerning milk	-29.4 (13.6)	0.031
Milk in dining halls viewed negatively	-31.6 (16.1)	0.050

¹⁾ Attitudinal and behavioral predictors of calcium intake determined by multiple linear regression modeling, controlling for gender.

²⁾ For each of the factors, calcium intakes increase or decrease, on average, by this many milligrams as the factor score increases by one point.

DISCUSSION

The main objective of the current study was to evaluate the attitudes and practices concerning milk and dairy consumption and their association with calcium intakes in college students. We demonstrated that calcium intakes were below the RDA of 1,000 mg/day, and when controlling for gender, dietary calcium was most strongly and directly related to associating milk with specific eating occasions and availability (i.e., storing calcium-rich foods in one's dorm or apartment). These data justify the need for, and provide direction in the design and testing of future evidence-informed behavioral interventions targeted to college students and aimed at improving calcium intake.

Low calcium intakes in college-aged populations are concerning given the ramifications for future bone health [1,2]. Our results align with previous research showing that many young adults do not meet recommended calcium intakes [7,10,11]. We also discovered that males compared to females had significantly higher calcium intakes. It has been suggested that lower calcium intakes in females compared to males may be due, in part, to lower energy intakes [27]. Total energy intakes of participants in our study were not measured, but it is possible that greater calcium intakes in males could be attributable to higher energy intakes. Regardless, these data point to the need to identify evidence-informed approaches to encourage adequate calcium intakes in this nutritionally at-risk population, particularly females who are more likely than males to have a lower calcium intake [28] and are at higher risk for osteoporosis later in the life due to menopause [29].

An assessment of the top ranking attitudes and behaviors concerning milk and dairy revealed numerous impactful findings, such as, on average, students strongly disagreed with the statement that they take calcium supplements. These data are consistent with a 2015 study of 1248 college students, males and females, in which the authors demonstrated that only 13% of students surveyed used a calcium supplement on a once weekly basis [30]. Worth noting, we also discovered a gender difference such that females were more likely to take calcium supplements than males. Given this finding, in combination with the evidence that females are more likely to have a lower daily calcium intake than males [28] and are at higher risk for osteoporosis [29], future research should examine the potential of calcium supplemental use targeted to females as part of an

intervention strategy.

Milk consumption and calcium intakes have been shown to be related to eating occasions such as breakfast in adolescents [7,17,19]. Similarly, the current study found that relating milk consumption with eating occasions (e.g., specific meals) was associated with higher calcium intakes in college students. Establishing meal associations during adolescence may set the stage for continuation of these behaviors later in life. It is also possible, however, that for some individuals these behaviors may be reversed during college due to an increased incidence of skipping breakfast or varying where meals are consumed [12]. For example, milk would be accessible during meals consumed in the dining hall, but not necessarily if meals were purchased from university cafe operations. With students living in apartments, availability of milk at meals could depend upon whether it was present in their residence or whether meals were eaten there or elsewhere on campus.

College students value convenience, a driver of food choices [31,32]. Our findings provide support for the influence of convenience, in that availability of calcium-rich foods in students' living quarters was associated with a higher calcium intake—when present and easily accessible, greater consumption is likely. Research on the foods kept in dorm rooms, however, suggests that these foods are not necessarily stored in one's residence. After categorizing all foods present in dorm rooms, investigators found that only 41% of students' rooms contained dairy products [8]. It is possible that refrigeration constraints could reduce students' ability to store dairy products in dorms. As such, novel efforts to make dairy products more convenient on college campuses, such as providing greater availability in dormitory vending machines, may be an effective means of increasing calcium consumption in college students.

Having family members who drink milk and viewing milk as healthy were both found to be positively associated with calcium intakes. Parental modeling has been recognized as a way to influence intake of foods and beverages [33]. For example, parents' dairy intake has been associated with adolescents' consumption of similar foods and beverages [20]. Previous family modeling of dairy consumption may help to establish habits in young adults that can be maintained once living away from home. Yet, research also suggests that students do not believe their families influence dietary habits while at school [13], and being away from family may pose challenges in adhering to previously established routines [14]. Holding positive views of milk as healthy may also be a learned behavior related to familial beliefs [34]. Personal conviction of dairy's importance in health could prove beneficial for young adults if it compels them to consume dairy products once living away from home. If a strong familial influence on both modeling of dairy intake and belief of dairy's health benefits is present, it is possible these factors could work synergistically to influence college students' calcium intakes.

Finally, one of the negative determinants of calcium intake included having parental rules concerning calcium intake. Among pre-adolescent children, there are data indicating that key parental practices concerning calcium-rich foods, including having rules and expectations, positively impact a child's calcium intake [18]. Findings from the current study indicate

the need for future research to understand how parental rules regarding impact their children's diet in the long-term (i.e., into young adulthood). Another negative determinant of calcium intake was having negative views of milk in dining halls. According to data from the Food Resources Education for Student Health intervention [35], it is possible to overcome this problem through student-led improvements to the campus food and nutrition environment for improved dairy intake. As such, future research will benefit from consideration of the target population (i.e., college students) in intervention design.

Strengths of the current study include a large sample size that represented a fairly even distribution of students from different class ranks and use of a validated questionnaire to measure calcium intake. Study limitations include a potentially biased sample (i.e., participants self-selected to take part in the survey) and a predominantly non-Hispanic Caucasian sample. Future research should explore whether similar factors influence calcium intakes in a more diverse college student population.

In summary, many participants did not achieve their age-specific RDA for calcium, signifying the continued need for strategies to increase calcium intakes in this population. In addition, adjusting for gender, associating milk with eating occasions (e.g., meals), storing calcium-rich foods in one's living quarters, viewing milk as healthy, having family members who drink milk, and taking calcium supplements were found to positively influence calcium intake in college students. Conversely, parental rules concerning milk and milk in dining halls viewed negatively were found to negatively influence calcium intakes in this population. Practitioners and researchers should consider the attitudinal and behavioral factors found here to positively or negatively impact calcium intake in the design of future interventions aimed at encouraging healthy dietary changes in college students.

CONFLICT OF INTEREST

The authors declare no potential conflicts of interests.

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