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Parents' Calcium Knowledge Is Associated with Parental Practices to Promote Calcium Intake Among Parents of Early Adolescent Children

Abstract

The study reported here aimed to identify the relationship of parents' calcium knowledge with diet-related parental practices and determinants of calcium knowledge. A cross-sectional survey was conducted measuring parental practices, calcium knowledge, and demographics. A convenience sample of 599 racially/ethnically diverse parents of children 10-13y completed questionnaires. Higher education and having a daughter were associated with higher calcium knowledge; being Asian or Hispanic and born outside the U.S. were associated with lower calcium knowledge. Parents with greater calcium knowledge were more likely to engage in healthy parenting practices. These factors may be important considerations for Extension educators in nutrition education.

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Introduction

Achieving adequate calcium intake, particularly during early adolescence (10 to 13 years old), is essential for reaching peak bone mass and reducing risk for osteoporotic fracture later in life (Power et al., 1999). Unfortunately, most U.S. early adolescents fail to meet the daily calcium RDA of 1,300 mg (NIH Office of Dietary Supplements, 2011). As nutrition gatekeepers in the home, parents play an important role in helping children achieve adequate calcium from calcium-rich foods and beverages (CRF/B) (Larson, Story, Wall, & Neumark-Sztainer, 2006). Interview data indicate that parents of early adolescents employ specific strategies, such as setting expectations for intake of CRF/B, making CRF/B available, and preparing CRF/B foods, to promote adequate intake of CRF/B in their child (Edlefsen et al., 2008). Several of these strategies were positively associated with calcium intake among children (Larson et al., 2006; Larson et al., 2009).

The Social Cognitive Theory (SCT) proposes that knowledge serves as a facilitator of behavior change (McAlister, Perry, & Parcel, 2008). With respect to dietary behaviors, knowledge of food sources of nutrients and dietary recommendations are considered key pieces of information in facilitating behavior change (Parmenter & Wardle, 1999). Education nutrition interventions targeted to early adolescents have demonstrated increases in calcium knowledge, as well as dairy intake (Savoie, 2006; McLean, Penniston. & Tanumihardjo, 2010). In the elderly, better calcium knowledge (food sources, dietary recommendations, and health impact of calcium) was associated with a higher daily calcium intake (Oudshoorn et al., 2012).

Under the SCT, parents' calcium knowledge would be expected to positively influence the strategies or practices employed by parents to improve their children's calcium intake; however, this information is not known. One study has provided evidence that if parents were equipped with adequate calcium knowledge they would be motivated to engage in practices that would promote intake of CRF/B among their children (Cluskey et al., 2008a). In this study, Asian, Hispanic, and non-Hispanic White parents were interviewed about their knowledge of CRF/B and the dietary intake of their early adolescents. While most parents were aware that calcium was required to build strong bones, specific knowledge about calcium functions, requirements, and food sources was limited. Furthermore, parents felt assured that their child was getting enough calcium if the child ate generally well, liked milk, and ate at school. However, after information was provided about calcium recommendations and the amount of various foods required to meet these recommendations, parents expressed surprise and commitment to ensure adequate calcium intake for their children.

Under the assumption that knowledge is a necessary resource to facilitate behavior change, Extension educators working in the area of nutrition and health invest time and effort delivering lessons on the topic of calcium to help limited resource parents engage in practices to improve children's CRF/B intake. And yet, to our knowledge, no study has been conducted to determine if parents' calcium knowledge is associated with parental practices that may influence child calcium intake. In addition, little is known about demographic determinants of parents' calcium knowledge. Consideration of factors that influence parents' knowledge about calcium requirements and dietary sources is critical in

the development of nutrition education programs (Eyles & Mhurchu, 2009).

The primary objective of the study reported here was to determine the relationship of parents' calcium knowledge (food sources and requirements) with parental behaviors or practices that may impact their children's calcium intake. We hypothesized that parents' calcium knowledge would positively relate to key parental practices that may impact children's calcium intake. The secondary objective was to determine demographic determinants of parental calcium knowledge. These objectives were examined among parents of early adolescent children.

Materials and Methods

Study Design and Sample Recruitment

This was a cross-sectional study based on a convenience sample of 10 to 13 year old children and the primary adult responsible for purchasing and preparing food at home. The data were collected in 2006-2007 as part of a multistate project. The objective of the previous study was to quantify parent psychosocial factors predicting calcium intakes of Asian, Hispanic, and non-Hispanic White early adolescents (i.e., racial/ethnic groups at a relative high risk for a low calcium intake and osteoporosis) (Siris et al., 2001). Participants were asked to complete a self-administered questionnaire. Because 98% of adult respondents were the child's parent, the respondent is referred to as the "parent" in this article. Other inclusion criteria included: 1) having lived in the U.S. for $\geq$1 yr; 2) ability to read or speak English; and 3) self-identifying as non-Hispanic White, Hispanic or Latino, Asian or Asian American, or a mixture of any of these. Parents (n=661) from 9 states (AZ, CA, CO, HI, MI, MN, OR, UT, WA) enrolled in the study and completed paper questionnaires. The current study focuses solely on the parent data.

Participants were recruited with fliers, verbal or written announcements in bulletins or newsletters, personal contacts, and presentations to groups/organizations (Cooperative Extension Service (EFNEP, SNAP-Ed, 4-H)); faith-based groups; after-school programs; sports teams; and scouting groups. The study protocol was approved by the IRB of each participating university.

Data Collection

Researchers used a standard data collection protocol. Questionnaires were distributed to parents and children in the home or community settings. In four states, questionnaires were distributed to all participants in person. In five states, researchers also used mailed packets to collect questionnaire data from parents (14%-50% of these five states). On average, parents took 30 minutes to complete the questionnaire and were given cash, gift certificates/gift cards, or merchandise as remuneration for completion. All questionnaires were completed in English.

Questionnaire Development

In a previous study, in-depth interviews were conducted with non-Hispanic White, Hispanic, and Asian parents/caregivers of early adolescents to assess parenting practices regarding consumption of CRF/B by children (Edlefsen et al., 2008); meal patterns at and away from home (Cluskey et al., 2008a);

and knowledge regarding calcium needs for parents and adolescents (Cluskey et al., 2008b). Findings were used to develop items for a quantitative parent questionnaire based on two major constructs: attitudes or preferences regarding parental intake of CRF/B = individual variables and socio-environmental factors regarding child intake of CRF/B = family variables. Researchers tested items for clarity and understanding, and revised as needed based on results from individual cognitive interviews with parents of varying race or ethnic background (9 Asians, 13 Hispanics, and 13 non-Hispanic Whites) across seven states. Items were used to construct 14 subscales that met standards for psychometric properties with Cronbach a-coefficients of 0.50-0.79 and Pearson correlation test-retest reliability coefficients of 0.68-0.85 (Reicks et al., 2011). Items included in subscales were reviewed for content appropriateness by experts at 10 universities.

Measurements and Variables

Demographic information about the parent, parent's spouse, and 10 to 13 year old child was gathered. The subscales constructed from questionnaire items assessed eight individual variables based on parents' attitudes and preferences regarding parental intake of CRF/B (not pertinent under the objectives of the current study and therefore individual variables not listed here), and six family variables based on parenting practices and perceptions regarding CRF/B intake by children (Reicks et al., 2011). Family variables included: making CRF/B available (frequency of having a variety of CRF/B in the home); encouragement (agreement with importance of encouragement and resulting behaviors); beverage expectations (frequency of allowing or expecting intake of specific beverage); access to CRF/B based on location (agreement with perception that their child obtains calcium from CRF/B and milk at school); importance of calcium sources (rating of importance of a variety of CRF/B to help their child obtain calcium); and family meal description (frequency of eating together based on schedules and management of the meal). In line with the primary objective of the current study, the family variables of interest included the three following parental behaviors: making CRF/B available; encouragement; and expectations.

Parents' knowledge regarding calcium requirements and sources was assessed with seven T/F or multiple-choice questions or statements (Table 2). Questions were derived from the NIH Calcium Fact Sheet, available to health professionals and the general public (NIH Office of Dietary Supplements, 2011). Parents' calcium knowledge score was calculated based on these seven questions/statements and scored as follows: one point assigned for each correct response and 0 if incorrect; Don't know or Not sure, for total of seven possible points. Scores were grouped into two categories (Low = 0-3 and High = 4-7). Cronbach a-coefficient was 0.70.

Data Analysis

Data were analyzed using SPSS software (version 22). Participants who selected multiple ethnic groups were classified as non-Hispanic White, Hispanic, or Asian if one of these groups was also selected. Data were excluded from analysis from parents not specifying race/ethnicity (n=24), who had been in the U.S. less than one year (n=1), without a 10-13 year old child (n=3), with missing data on calcium knowledge score components (n=19), and/or with reported calcium intakes considered implausible (<100 mg/d or >2500 mg/day; Matlik et al., 2007) (n=15). Chi-square tests were used to determine

differences in demographic or household factors by low or high calcium knowledge score.

For the primary study objective (determine relationship of parents' calcium knowledge with key parental practices), a multivariate linear regression model was used to determine whether the independent variable (calcium knowledge score 0-7 points) was associated with the dependent variables (three parental practices—availability; encouragement; expectations). For the secondary study objective (identify demographic determinants of parents' calcium knowledge), a separate multiple linear regression model was used. Demographic variables (age and gender of child; age and gender of parent, and education level of parent; household size and composition; race/ethnicity and employment of parent and spouse/partner; participation in federally funded nutrition assistance programs; likelihood of speaking English at home; likelihood that the respondent and/or close family members were born outside the U.S.) were entered as explanatory variables. A backward selection procedure was used to eliminate factors that were not significantly associated with the dependent variable (parental calcium knowledge). Adjustment for sampling design was made by including state in the models. Significance was set at $P < 0.05$.

Results

Half of the respondents indicated they were over 40 years of age (52%); 38% had a college degree, and 27% participated in a nutrition assistance program. Respondents were non-Hispanic White (46%), Hispanic (36%), or Asian (18%). Sixty-nine percent were born in the U.S., and 56% reported speaking only English at home. Most respondents were mothers of the children (87%), and 75% were employed full or part-time. Mean age of child was 11.6 ± 1.1 years; 55% were female (Table 1).

Table 1.

Selected Characteristics of Parents of Early Adolescent Children (10-13 Years) by Calcium Knowledge Score

Calcium Knowledge Score Group[a]				
Characteristics of Parents/Household	**All Parents**	**Low**	**High**	**P-value[b]**
	n = 599	**n = 220**	**n = 379**	
	n (%)[c]			
Calcium Knowledge Score		220 (36.7)	379 (63.3)	
Age of Child[d] (years)				0.07
10	134 (22.4)	62 (28.2)	72 (19.0)	
11	165 (27.5)	55 (25.0)	110 (29.0)	
12	115	37	78	

	(19.2)	(16.8)	(20.6)	
13	185 (30.9)	66 (30.0)	119 (31.4)	
Gender of Child[d]				0.04
Boy	269 (44.9)	111 (50.5)	158 (41.7)	
Girl	330 (55.1)	109 (49.5)	221 (58.3)	
Age Group of Parent				0.01
18-40 years	288 (48.1)	121 (55.0)	167 (44.1)	
41-51+ years	311 (51.9)	99 (45.0)	212 (56.0)	
Education of Parent				<0.001
High School or Less	179 (29.5)	93 (42.5)	83 (22.0)	
Some College/Technical School	193 (32.4)	66 (30.1)	127 (33.7)	
4-Year College/Advanced Degree	227 (38.1)	60 (27.4)	167 (44.3)	
Race/Ethnic Group				<0.001
Asian	108 (18.0)	51 (23.2)	57 (15.0)	
Hispanic	214 (35.7)	106 (48.2)	108 (28.5)	
Non-Hispanic White	277 (46.2)	63 (28.6)	214 (56.5)	
Nutrition Assistance Program Participation[e]				
None	440 (73.5)	140 (63.6)	300 (79.2)	<0.001
WIC, SNAP, or F/R School Meals	159 (26.5)	80 (36.4)	79 (20.8)	
Parent Birthplace				<0.001

Foreign Born	183 (31.2)	102 (48.3)	81 (21.5)	
U.S. Born	404 (68.8)	109 (51.7)	295 (78.5)	
Language Spoken at Home				<0.001
No English	62 (11.7)	42 (21.9)	20 (5.9)	
Another Language > English	50 (9.4)	19 (9.9)	31 (9.1)	
Another Language = English	70 (13.2)	29 (15.1)	41 (12.1)	
English > Another Language	60 (11.3)	28 (14.6)	32 (9.4)	
English Only	290 (54.5)	74 (38.5)	216 (63.5)	

[a]Parent calcium knowledge score: one point if correct, 0 if incorrect, Don't Know or Not Sure, for a total of seven possible points, groups: Low = 0-3 points, High = 4-7 points.

[b]P-Value according to Chi Square analysis (p<.05).

[c]Numbers do not always add up to 100% due to rounding and missing data.

[d]Characteristics of children of parent respondents, all others are for parent respondents.

[e]Nutrition Assistance Programs include: WIC=Special Supplemental Nutrition Program for Women, Infants, and Children, SNAP=Supplemental Nutrition Assistance Program, or F/R School Meals=Free/Reduced-Price School Meals.

The majority of parents (>55%) correctly answered the five T/F questions. About half (47.8%) incorrectly responded to the question, "How many cups of milk would a 10-13 year child need to drink each day to get the calcium he/she needs?" And most parents (93.8%) incorrectly responded to the other question, "How many cups of broccoli give the body as much calcium as 1 cup of milk?" Mean calcium knowledge score was 4.00 ± 1.6 (range 0-7) (Table 2).

Table 2.

Survey Items Assessing Parent Calcium Knowledge and Scoring Results[a]

	Correct	**Incorrect**	**Don't Known**

	n (%)	n (%)	(%)
Boys need more calcium than girls. (answer: False)	339 (56.6)	44 (7.3)	216 (36.1)
Most 10-13 year-old girls are not getting enough calcium. (answer: True)	409 (68.3)	32 (5.3)	158 (26.4)
Most 10-13-year-old boys are not getting enough calcium. (answer: True)	374 (62.4)	50 (8.3)	175 (29.2)
If people don't get enough calcium in their diet, a vitamin and mineral pills can help. (answer: True)	420 (70.1)	63 (10.5)	116 (19.4)
When you are an adult, you don't need calcium every day. (answer: False)	507 (84.6)	44 (7.3)	48 (8.0)
	Correct n (%)	Incorrect n (%)	Not sure n (%)
How many cups of milk would a 10-13-year-old child need to drink each day to get the calcium he/she needs? (answer: 3 or 4 cups)	313 (52.3)	128 (21.4)	158 (26.4)
How many cups of broccoli give the body as much calcium as 1 cup of milk? (answer: 3-4 cups)	37 (6.2)	208 (34.7)	354 (59.1)
	Mean (SD)		
Total Score	4.0 (1.6)		

[a]Parent calcium knowledge score (n=599 parents) was calculated based on seven questions scored as follows: one point if correct, 0 if incorrect, Don't Know or Not Sure, for a total of seven possible points.

Thirty-seven percent and 63% of parents fell in the low and high knowledge groups, respectively. Those in the high versus low knowledge group were more likely to: have female children; be more educated; be non-Hispanic White; not be participating in a nutrition assistance program; be U.S. born; and speak only English at home (Table 1).

Having a higher education and having a female child were associated with higher calcium knowledge, while being Asian or Hispanic compared to non-Hispanic White and being born outside the U.S. were negatively associated with calcium knowledge, after adjusting for state of residence. Subscale scores for making CRF/B available, encouragement of CRF/B, and setting expectations for child intake of healthy beverages were positively associated with parent calcium knowledge (Table 3).

Table 3.

Multiple Linear Regression Model for Parent Calcium Knowledge Score and Parent/Household Characteristics

	Y= Calcium Knowledge Score (0-7 Points)[a]	
	R^2=0.109; p<0.001	
Independent Variables	**B[b] ± SE**	**P-value**
Parent/Household Characteristics		
Parent Education (HS Diploma or Less=0, Some College or More = 1)	0.36 ± 0.17	0.033
Hispanic (Reference – NHW)	-0.48 ± 0.18	0.008
Asian (Reference – NHW)	-0.67 ± 0.20	0.001
Gender of Child (Boy=0, Girl=1)	0.27 ± 0.13	0.034
Non-Domestic Birthplace (Reference – U.S. born)	-0.54 ± 0.18	0.002

SE = standard error.

NHW = Non-Hispanic White

[a]Parent calcium knowledge score: seven questions where one point if correct, 0 if incorrect, Don't know or Not sure, for a total of seven possible points.

[b]β represents differences in calcium knowledge scores among parents based on variables as labeled and adjusted for state of residence.

Table 4.

Multivariate Linear Regression Model for Parent Calcium Knowledge Score and Parental Practices

	X= Calcium Knowledge Score (0-7 Points)[a]		
Dependent Variables	**B[b] ± SE**	**P-value**	**R^2**
Parental Practices			
Availability	0.027 + 0.01	0.03	0.008
Encouragement	0.09 ± 0.01	<0.001	0.079
Beverage Expectations	0.035 ± 0.01	0.004	0.017

SE = standard error.

[a]Parent calcium knowledge score: seven questions where one point if correct, 0 if incorrect, Don't know or Not sure, for a total of seven possible points.

[b]β represents differences in calcium knowledge scores among parents based on variables as labeled and adjusted for state of residence.

Discussion

In the sample of parents of early adolescents, respondents' ability to correctly answer questions addressing calcium requirements was moderate, with most correctly answering four/seven questions. However, most parents incorrectly answered the two questions that addressed food sources and requirements of calcium. These results are similar to those of another study (Cluskey et al., 2008a) in which calcium knowledge among Asian, Hispanic, and non-Hispanic White parents of adolescents was inadequate, with greatest knowledge failures regarding total amount of calcium needed, number of servings of any given CRF/B source needed to meet calcium requirements, and need for calcium throughout life. These results also parallel to findings from a study (Vue & Reicks, 2007) in which parent knowledge of calcium requirements of pre-adolescent girls was limited.

Demographic determinants of parent calcium knowledge were identified. Having a higher education was related to higher calcium knowledge among parents. This finding is similar to studies demonstrating that socioeconomic status (SES) is positively associated with nutrition knowledge (Mann, Hildreth, Draughn, & Hegsted, 1989, Wang & Chen, 2011). In a study of elderly adults, those with a higher SES scored higher on knowledge of calcium requirements (Mann et al., 1989); in another study, adults with more education scored higher on nutrition knowledge and beliefs (Wang & Chen, 2011).

Another discovery was that higher parents' calcium knowledge was associated with having a female child. Several nationwide campaigns promote dietary calcium as playing a critical role in optimizing bone mass and highlight women as having a greater risk than men (Gass & Dawson-Hughes, 2006). Consequently, parents of daughters may have greater knowledge of calcium. Limited knowledge of calcium requirements may be related to the majority of U.S. women and girls failing to meet the recommended intake and females having a lower calcium intake than males across all age groups (Miller, Jarvis, & McBean, 2011). Future campaigns could place greater emphasis on improving parents' knowledge of calcium requirements.

Being an Asian parent compared to non-Hispanic White parent was negatively associated with calcium knowledge. In another study, Asian parents were likely to fall into consumer segments described as sweet-drink-permissive parents, with a tendency to allow their children to consume sugar-sweetened beverages (Reicks et al., 2011), which could displace calcium-rich beverages. Calcium knowledge was lower for these parents compared to the dedicated-milk providers/drinkers segment who were likely to be non-Hispanic White. Being a Hispanic parent versus non-Hispanic White parent was also negatively associated with calcium knowledge. This result bares similarity to results from a study of Hispanic parents of young children, ages 3 to 10 years old, where mothers' knowledge of relationship of obesity

prevention messages and child weight study was low compared to non-Hispanic White and Black mothers (Vollmer & Mobley, 2013). Thus, Asian and Hispanic parents may be in greater need for intervention.

In addition, being born outside the U.S. was associated with a lower parental calcium knowledge score compared to being born domestically. This finding is similar to results from a study of low-income parents of young children, ages 2 to <6 years old, in which children of non-U.S. born parents were at higher risk for engaging in poor health behaviors (sleep routines, active play time, screen time) compared to their U.S. born counterparts, adjusted for both parental education and child race/ethnicity (Cespedes et al., 2013). These data, which warrant further research considering the increasing percentage of U.S. children with a non-U.S. born parent, indicate that future nutrition and health interventions may need to tailor approaches to these two diverse subpopulations.

Finally, the three parent practices under examination in the current study (availability, encouragement, and expectations) were positively associated with calcium knowledge. Consistent with SCT (McAlister et al., 2008), parental calcium knowledge may translate into practices that promote CRF/B consumption. Engagement in these parent practices may be motivated by parent knowledge regarding consequences of inadequate intake and facilitated by knowledge regarding food sources and recommendations. Important, certain studies have shown that parental nutrition knowledge may actually enhance children's *consumption* of healthy foods (Gibson, Wardle, & Watts, 1998; Pearson, Biddle, & Gorely, 2009). And other studies have demonstrated that these key parenting practices may enhance child diet quality. In a recent study of 10-14 year old Hispanic children (n=186), availability of sugar-sweetened beverages in the home was associated with a poor diet quality (Santiago-Torres, Adams, Carrel, LaRowe, & Schoeller, 2014). Other studies have found that parental encouragement and having rules/expectations for children to consume healthy foods, positively influence a child's intake of these foods (Pearson et al., 2009). Thus, educating parents about CRF/B may promote positive parenting practices that improve child calcium intake.

In summary, findings from the study reported here demonstrate that parents with less education and born outside the U.S. have lower calcium knowledge scores, suggesting that these individuals are in higher need of intervention. Higher knowledge scores among non-Hispanic Whites compared to other groups support the importance of a focused calcium education program directed toward Asian and Hispanic parents. Having a girl was associated with greater calcium knowledge among parents, which suggests many parents are successfully attending to the information they receive from health professionals regarding the importance of adequate calcium intake. Parents with greater calcium knowledge were more likely to make CRF/B available, set expectations for CRF/B intake and encourage consumption of CRF/B pointing to the critical role of nutrition education in establishing these positive parent practices.

Implications

According to the SCT, knowledge is required for enabling behavior change (McAlister et al. 2008). Under this assumption, Extension educators, 4-H professionals, and other outreach professionals working in the area of nutrition and health are tasked with the responsibility of teaching lessons on the topic of calcium and bone health to help parents living in low income situations engage in practices

that might improve their children's CRF/B intake. Considering the time, money, and other resources invested by the Extension network to support educators in delivery of nutrition programming, the limited information available in the peer-reviewed literature on this topic of parent calcium knowledge and diet-related parental practices is alarming. To our knowledge, the study reported here is the first study of its kind demonstrating that, among a racially and ethnically diverse sample of parents of early adolescent children living in the U.S., calcium knowledge is directly related to key parental practices (making CRF/B available, encouraging intake of CRF/B, setting expectations for CRB) that may increase children's calcium intake. While further studies with stronger study design are needed to confirm results from the study, the implication of these findings for Extension are important as they provide justification for work of field educators.

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