5-2004

Assessment of Calcium, Milk, and Non-Milk Beverage Intake of Multiethnic Youth Aged 10 to 18 Years

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ASSESSMENT OF CALCIUM, MILK, AND NON-MILK BEVERAGE INTAKE OF MULTIETHNIC YOUTH AGED 10 TO 18 YEARS

by

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A dissertation submitted in partial fulfillment
of the requirements for the degree

of

DOCTOR OF PHILOSOPHY

in

Nutrition and Food Sciences

UTAH STATE UNIVERSITY
Logan, Utah

2004

ABSTRACT

Assessment of Calcium, Milk, and Non-Milk Beverage Intake

of Multiethnic Youth Aged 10 to 18 Years

by

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Utah State University, 2004

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Achieving and maintaining maximal peak bone mass is critical to the prevention of osteoporosis. Adequate calcium intake during youth is a major aspect of proper bone mass development. Because of the importance of calcium, a food frequency questionnaire (FFQ) that estimates calcium intake of 10- to 18-year-old Asian, Hispanic, and white youth living in the western United States was developed. This new FFQ was shown to accurately and reliably estimate calcium intake of these youth. Accuracy among Hispanics, however, was low and requires further evaluation. A second study examined intake of calcium, milk, and non-milk beverages of Hispanic and non-Hispanic white children aged 10 to 11 years and 15 to 18 years living in Utah. Milk fat percentage and source of beverage procurement were considered. Studies assessing the intake of calcium, calcium-rich foods, and foods that may interfere with calcium intake of youth in the United States were reviewed.

(108 pages)

ACKNOWLEDGMENTS

I am grateful to my major professor, Dr. Deborah Gustafson, who has encouraged me along and provided invaluable advice and help. I would also like to thank other members on my committee, including Drs. Nedra Christensen, Ronald Munger, Deloy Hendricks, Richard Cutler, and Georgia Lauritzen, for sharing their knowledge and taking time to help me complete my degree.

I would like to thank Pam Zetterquist and Pam Nielson for their help, encouragement, and cheerfulness. I am grateful to the faculty of Nutrition and Food Sciences who have been helpful in so many very meaningful ways throughout the past years.

I thank my mother and father for their patience, encouragement, and support. I am grateful to my wife for the help she has been through the many long days and nights.

The research reported in this publication was supported by funding from the Vice President for Research and the Utah Agricultural Experiment Station at Utah State University.

J. Keith Jensen

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CHAPTER 1

INTRODUCTION

Osteoporosis is a major health problem that affects both sexes and all ethnicities to varying degrees (1). Achieving maximal peak bone mass during the growing years may alleviate the burden of osteoporosis later in life (1-4); therefore, interventions to prevent osteoporosis should begin early in life. Hormonal sufficiency, proper exercise, optimal nutrition, and the absence of smoking during the first few decades of life, especially during puberty when bone mass accretion is at its highest rate, are necessary to maximize the development of peak bone mass within an individual's genetic potential (1-11).

Since nutrition during puberty is a key factor in the achievement of maximal peak bone mass, studies that clearly quantify the food and nutrient intake of older youth and adolescents from different ethnicities and ages are essential to the creation of effective nutrition interventions for the prevention of osteoporosis. Several nutrients play a role in optimal bone mass accretion, and calcium is probably the most important (1-8). Mean calcium intake among 9- to 13-year-olds and 14- to 18-year-olds living in the United States falls short of the current recommendations (12,13); therefore, nutrition education for the prevention of osteoporosis should concentrate on all bone-related nutrients and foods with an emphasis on calcium intake.

Proper dietary assessment is critical for the creation of meaningful nutrition intervention that addresses prevention of osteoporosis. Twenty-four hour dietary recalls and food frequency questionnaires (FFQs) are two survey methods commonly used to assess diet. These methods are used to determine relationships among foods and nutrients and other factors such as age, gender, ethnicity, environment, behavior, growth, and health. A single 24-hour recall collected from many individuals may be used to describe the mean food, nutrient, or food component intake of a group. Advantages to using a 24-hour recall are its unlimited specificity in type of food consumed and its minimal relative burden on the respondent compared to other survey methods (14,15). A disadvantage is that 24-hour recalls are time and cost intensive. A semi-quantitative FFQ is designed to rank individuals according to their usual intake of foods, nutrients, and food components. Advantages to using an FFQ include its ability to assess usual intake over a long period of time and its relatively low cost and ease of administration (14,15). An FFQ is most useful if it is tailored to the population being studied (16-18); yet, few FFQs have been created or modified to measure dietary intake among youth in the United States, particularly youth of various ethnic backgrounds (19,20). Because of the importance of calcium in achieving maximal peak bone mass and because of the relatively low calcium intake observed among older youth and adolescents of all ethnicities in the United States, an FFQ that specifically addresses calcium intake among multiethnic youth in the United States may lead to improved educational strategies to prevent or alleviate the problem of inadequate calcium intake.

The purpose of this project was to carry out two studies that enhance our understanding of the intake of calcium among 10- to 18-year-old Asian, Hispanic, and white youth living in the western United States. The first study, "Development of a Food Frequency Questionnaire to Estimate Calcium Intake of Asian, Hispanic, and White Youth," describes the creation of an FFQ that accurately and reliably estimates calcium intake among 11- to 18-year-old Asians, Hispanics, and whites living in the western

United States. Appendix A contains the 24-hour dietary recalls used to develop the FFQ, and Appendix B contains the final version of the FFQ. This instrument will serve as a tool for current and future research. The second study, "Intake of Calcium, Milk, and Other Beverages of Hispanic and White Older Youth and Adolescents Living in Utah," assesses the intake of calcium, milk, and beverages that may displace milk. Milk fat percentage and locations of where the milk and other beverages were obtained are addressed. Assessments were based on data collected via 24-hour dietary recalls (Appendix A). Appendix C contains the Household Questionnaire, which was used to assess demographic information.

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CHAPTER 2

DEVELOPMENT OF A FOOD FREQUENCY QUESTIONNAIRE TO ESTIMATE CALCIUM INTAKE OF ASIAN, HISPANIC, AND WHITE YOUTH[1,2]

Abstract

Objective To develop a food frequency questionnaire (FFQ) that estimates calcium intake of Asian, Hispanic, and white youth living in the western United States.

Design A list of 80 foods was assembled to create an FFQ to measure calcium intake. Evaluation of the FFQ spanned 4 consecutive weeks. An FFQ was completed during week 1 and week 4, and a 24-hour dietary recall was completed during week 2 and week 3.

Subjects/setting A convenience sample of 162 Asian, Hispanic, and white youth ages 10 to 18 years was selected.

Statistical analyses performed Percent agreement, paired *t*-tests, Pearson correlation coefficients of cube-root transformed values, and deattenuated Pearson correlation coefficients of cube-root transformed values were used to evaluate the FFQ.

Results The correlation between calcium intake estimates, when measured by first and

[1] Reprinted from the Journal of the American Dietetic Association, volume 104, J. Keith Jensen, Deborah Gustafson, Carol J. Boushey, Garry Auld, Margaret Ann Bock, Christine M. Bruhn, Kathe Gabel, Scottie Misner, Rachel Novotny, Louise Peck, and Marsha Read, Development of a Food Frequency Questionnaire to Estimate Calcium Intake of Asian, Hispanic, and White Youth, pages 762-769, copyright 2004, with permission from American Dietetic Association.

[2] This report is based on research conducted and supported by State Agricultural Experiment Station Western Multistate Research Project No. W-191, Factors Influencing Intake of Calcium Rich Foods Among Adolescents, with the Agricultural Experiment Stations in Arizona, California, Colorado, Hawaii, Idaho, Indiana, New Mexico, Nevada, Utah, Washington, and Wyoming participating. J. Keith Jensen was supported by funding from the Vice President for Research and the Utah Agricultural Experiment Station at Utah State University.

second administrations of the FFQ, was 0.68 (Pearson's r) for the total sample. Correlations differed by age, sex, and ethnic subgroups as follows: 10 to 13 years (r=0.62), 14 to18 years (r=0.73), male (r=0.73), female (r=0.64), Asian (r=0.77), Hispanic (r=0.72), and white (r=0.48). The correlation between calcium intakes as estimated by the second FFQ vs the average of the two 24-hour dietary recalls was 0.54 (deattenuated Pearson's r) for the total sample. This correlation differed by age, sex, and ethnic subgroups as follows: 10 to 13 years (r=0.46), 14 to18 years (r=0.59), male (r=0.65), female (r=0.45), Asian (r=0.64), Hispanic (r=0.18), and white (r=0.57). **Conclusions** A unique dietary survey has been developed to estimate calcium intake among Asian, Hispanic, and white youth in the United States.

INTRODUCTION

Osteoporosis is a major public health problem that affects every sex, race, and economic group, particularly after age 50 years (1-5). Obtaining sufficient calcium during youth contributes to adequate mineralization of the skeleton and achievement of peak bone mass to ensure healthy bones later in life (6). Thus, osteoporosis has been described as a pediatric disease that manifests itself in old age (7). Youth in the United States are not consuming sufficient calcium to reach peak bone mass – potentially leaving themselves vulnerable to osteoporosis. Particularly susceptible are youth of Asian or Hispanic heritage who have a higher risk of osteoporosis compared to whites. African American heritage is associated with a lower risk (5).

To address this calcium crisis, several investigators (8-10) have attempted to identify factors associated with low consumption of calcium-rich foods among youth.

These studies have relied on 24-hour recalls and food records for estimating calcium intake. Although these methods have been successful in measuring calcium in this target group, these methods are time consuming and resource intensive.

A dietary assessment method with lower respondent and investigator burden is the food frequency questionnaire (FFQ). Few FFQs have been created or modified to measure dietary intake among youth in the United States (11,12), particularly youth of various ethnic backgrounds. An FFQ is most useful if it is tailored to the population being studied (13).

The US Department of Agriculture's (USDA) multistate project, W191, was initiated to identify salient factors affecting the consumption of calcium-rich foods among youth representing the race/ethnic groups most at risk for osteoporosis, namely Asians, Hispanics, and whites. Therefore, a method to assess calcium intake was needed. Our goal was to develop a questionnaire that could be self-administered and contained calcium food sources important to Asian, Hispanic, and white youth. In addition, the instrument needed to be comprehensible to sixth graders, while not considered childish to 11th graders. We decided to use a semi-quantitative food frequency measure because youth are limited in their abilities to estimate portion sizes accurately, frequency of consumption is considered more important than serving size (14,15), and this approach has previously been successful with youth (12). This article describes the development of an FFQ designed to meet the specific research objectives of accurately and reliably measuring calcium intake of 10- to 18-year-old Asian, Hispanic, and white youth living in the western United States.

METHODS

Creation of the Food Frequency Questionnaire

Investigators created a list of 80 foods that were thought to supply substantial amounts of calcium to the diets of Asian, Hispanic, and white youth. Foods were selected for inclusion in the food list based on examination of food composition tables, existing dietary questionnaires, and epidemiological data on food consumption patterns of Asian, Hispanic, and white youth in the United States. Soda pop, fruit-flavored drinks, coffee, and tea were also included in the list of foods because they replace milk and other high-calcium foods. A glossary of calcium-containing foods and dishes was available to study staff administering the FFQ so consistent definitions of unfamiliar foods were provided to all participants. See Figure 2-1 for a list of foods included on the FFQ and Figure 2-2 for the glossary.

The food list was converted into a semi-quantitative FFQ similar to the format of the Youth/Adolescent Questionnaire (16). For each food item, a commonly used portion size was listed along with a question asking how often, on average, the food portion was consumed during the past month. Each food item had between four and seven frequency responses, which ranged from "Never or less than once per month" to "Four or more servings per day." Questions regarding dietary supplement use and eating patterns were included. Open-ended questions regarding brand names of vitamin and mineral supplements, protein supplements, and breakfast cereals were also incorporated.

Beverages
Soda pop, any type
Fruit flavored drinks such as Hawaiian Punch,[a] lemonade, Kool-Aid,[b] or other noncarbonated fruit drink
Carbonated fruit drink
Orange juice
Café latte, café mocha, cappuccino, or café au lait
Coffee or tea
Cocoa (hot chocolate) made with milk
Dairy products
Milk to drink, white or chocolate
Milk on cereal
Soy milk
Instant breakfast drink such as Carnation Instant Breakfast[c]
Yogurt, not frozen
Blended yogurt and juice drink or yogurt drink
Pudding, custard, or flan
Frozen yogurt or ice cream
Milk shake, malt, or frappe
Cheese
Cheese spread orange-colored, such as Cheez Whiz[b]
Cottage cheese
Combination Foods
Macaroni and cheese
Lasagna with cheese, cheese tortellini, or cheese ravioli
Nachos with cheese
Hamburger or hot dog without cheese on a bun
Hamburger or hot dog with cheese on a bun
Breakfast sandwich with cheese
Grilled cheese sandwich
Pizza
Enchilada: beef, chicken, or pork
Enchilada: cheese
Bean burrito
Taco
Tamales
Quesadilla
Chile relleno
Soup or chowder made with milk
Stir fry vegetables, no meat
Stir fry shrimp and vegetables
Stir fry beef, pork, or chicken and vegetables
Vegetables, Grains, and Nuts
Broccoli, cooked
Broccoli, raw
Dark green leafy vegetables such as spinach, leafy greens, bok choy, or taro leaves
Carrots, cooked or raw
Kimchee or pickled cabbage
Cheese on vegetables
Cold cereal
Bread, toast, or pita
Muffin, any type
Pancakes, waffles, or French toast
Bagel
Hominy or posole
Atole
Polenta
Miso
Corn tortilla, yellow
Flour tortilla, white
Poi made from taro
White rice, cooked
Mashed potatoes
Whole cooked beans such as kidney, pinto, or baked beans
Adzuki bean foods such as mochi
Refried beans
Soybeans, cooked
Natto or fermented soybean
Tofu
Almonds
Seafood
Shellfish such as shrimp or scallops
Sardines, smelts, or herring
Salmon or chum, canned
Mixed seafood such as poke or sushi
Small dried fish
Other Foods
Cheese and crackers snack packs such as Snackables[b]
Granola bar with chocolate
NutriGrain[d] or NutriGrain Twist[d] bar
Cream pie such as banana, chocolate, pumpkin, or coconut
Cupcakes or cake
Chocolate candy bar
Chocolates, chocolate kisses, or bite sized candy bars
Oriental snack mix such as arare
Dry seaweed or nori
Oatmeal, instant

[a]Dr Pepper/Seven UP, Inc, Plano, TX.
[b]Kraft Food, Northlake, IL.
[c]Nestlé Carnation, Glendale, CA.
[d]Kellogg Company, Battle Creek, MI.

Figure 2-1. Food included on the food frequency questionnaire used to estimate calcium intake in Asian, Hispanic, and white youth.

Arare- thin cracker made of rice flour with added ingredients such as seaweed; Japanese origins.
Atole- a thick beverage made of masa (a special type of cornmeal), water or milk, and crushed fruit or sugar and honey; Latin American origins.
Azuki beans- a small red oval red bean, eaten cooked and mashed as a filling for confections; Japanese origins.
Bean burrito- a soft tortilla stuffed with beans; originally from Latin America.
Bok choy- a green leafy vegetable of the cabbage family; white stem and green leaves; Chinese origin.
Chile relleno- literally "filled pepper", a pepper stuffed with meat or cheese; originally from Latin America.
Enchilada- a soft tortilla stuffed with cheese and usually some type of meat; usually covered with red or green chile sauce and baked; originally from Latin America.
Hominy- large, puffy kernels of soft corn.
Kim chee- a dish made of pickled (with salt, garlic, ginger and chili) cabbage, cucumber, daikon or seaweed; originally from Korea.
Mochi- a sticky cake made of steamed, pounded rice flour, often stuffed with azuki bean paste; of Japanese origin.
Nachos- tortillas chips with melted cheese; originally from Latin America.
Natto- fermented soy bean paste; Japanese origin.
Nori- blackish/purplish/greenish sheets of dried seaweed used in Japanese dishes.
Poi- a gelatinous (gooey) paste made from pounding steamed or boiled root vegetables (usually taro, sometimes breadfruit or sweet potato) and fermenting; Hawaiian and Polynesian origin.
Poke- fresh, raw fish seasoned with soy sauce, salt, kukui nut, sesame seed paste, chili peppers, or seaweed; Hawaiian.
Polenta- a mush made from cornmeal, eaten hot with a little butter or cooled until firm, cut into squares and fried.
Posole- a stew made with hominy (large, puffy kernels of soft corn), chiles, and usually some type of meat such as pork.
Quesadilla- a flour tortilla folded in half with melted cheese inside; originally from Latin America.
Soymilk- a milk-like drink from soybeans; origins in Asian countries such as China and Japan.
Sushi- rice flavored with sweet vinegar sauce; Japanese origins.
Taco- a crisp tortilla shell with meat or cheese and vegetables, usually chopped lettuce and tomatoes; originally from Latin America.
Tamale- made of steamed corn meal and stuffed with meat; originally from Latin America.
Taro leaves- leaves of the taro root plant; consumed cooked; originally from Polynesian regions.
Tofu- soy bean curd; Chinese and Japanese origins.

Figure 2-2. Glossary of calcium-containing foods.

Participants

Recruitment of youth was based on the ethnic/racial profiles of six western states and those populations at highest risk for the development of osteoporosis. California and Washington were assigned to recruit Asian, Hispanic, and white youth; Arizona and Nevada were assigned Hispanic and white youth; Hawaii was assigned Asian youth; and Idaho was assigned white youth. Participants were recruited from schools, churches, and youth clubs targeted for their demographic mix. Participants were required to provide written consent for data collection according to guidelines outlined by each participating university's Institutional Review Board.

Study Design

A study to evaluate whether the FFQ adequately measures calcium intake was conducted in fall 1999 and winter 2000. The activities for each participant enrolled in the study spanned four consecutive weeks (Figure 2-3). The first administration of the FFQ (FFQ1) was completed during week 1. A 24-hour dietary recall was completed during each of weeks 2 and 3. The second administration of the FFQ (FFQ2) occurred during week 4. Our goal was to complete approximately 75% of the 24-hour recalls on weekdays and 25% on weekends.

Week 1	Week 2	Week 3	Week 4
↑	↑	↑	↑
FFQ1[a]	Recall1[b]	Recall2	FFQ2

[a] FFQ = food frequency questionnaire.
[b] Recall = 24-hour dietary recall.

Figure 2-3. Development of a food frequency questionnaire to estimate calcium intake in multiethnic youth study schedule.

24-Hour Recalls

Collection of 24-hour recalls was based on methodology used in the Continuing Survey of Food Intakes by Individuals, 1994-1996 (CSFII) (17). A brief overview and justification of our modified CSFII methodology follows. The dietary recalls were face-to-face interviews that assessed a participant's food intake from the previous day. We utilized the CSFII Food Instruction Booklet to promote a consistent interview style among the interviewers and to increase the use of neutral probes to avoid influencing a participant's response. Food models; measuring cups and spoons; rulers; concentric circles; and various-sized bowls, glasses, cups, and plates were used to determine portion sizes.

The standard three-pass method was used (17) with some modifications. The modified passes included the creation of a quick list of foods along with the time they were consumed, a detailed description of the foods and the amount consumed, the name of each eating occasion and the location from which the foods were obtained, and a review of food intake. At the end of the interview, we made assessments regarding usual food intake, dieting status, vitamin and mineral supplementation, and food allergies or intolerances.

Another modification to the CSFII protocol occurred during the process of making the quick list of foods. Participants were asked to use mental imagery and chronologically recount the previous day's events and activities to help them remember where, when, and what they ate (18). Participants were allowed to skip portions of the day that they could not remember. Interviewers assessed those forgotten portions of the day after the rest of the quick list of foods was made. If at this point a participant still could not remember, the forgotten portions were assessed even later in the interview process. The modified three-pass process allowed for this to naturally occur.

Training of participating study sites in the modified CSFII protocol was accomplished over the telephone with the principal investigators of the six study centers involved in the evaluation of the FFQ. A registered dietitian (JKJ) conducted the training. An open dialogue was maintained to answer questions concerning the protocol.

Twenty-four-hour recalls were analyzed using The Food Processor® computer program (version 7.6, 2000, ESHA Research, Salem, OR). All dietary recalls were double-checked by a registered dietitian (JKJ) to ensure that the most accurate calcium value was assigned to each food reported during the recalls. Calcium values for foods without brand names were based on USDA values (19). If brand names were reported, the calcium value was used only if the manufacturer supplied a value other than zero or missing. Some low-calcium foods did not have a calcium value reported by either USDA or a manufacturer. These missing values were considered negligible and were ignored. Recipes were created for foods that could not be found within the ESHA database (eg, homemade stir fry).

Food Frequency Questionnaires

FFQs were self-administered, but a moderator was present to provide guidance and answer questions. Data entry for the FFQs was done by hand because the forms were not scannable by a computer. Data were entered twice to ensure accuracy.

Determining a calcium value for each item listed on the FFQ was based on the 24-hour recall data. After analyzing the 24-hour recalls in The Food Processor®, the foods were exported to the SPSS software program (version 10.0.7, 2000, SPSS Inc, Chicago, IL) for further analysis. In total, 5,255 foods were recorded from the recalls. Each food item included a serving size, a gram weight, an energy value, a calcium value, and calcium density values per 100 g and 100 kcal of food. Foods were sorted, and assigned to corresponding food items on the FFQ. For example, all types of milk consumed on cereal (ie, whole, 2%, 1%, skim) were assigned to the FFQ food item "Milk on cereal" and all types of carbonated soft drinks were assigned to the FFQ food item "Soda pop, any type." A calcium value was assigned to each food item on the FFQ based on frequency of consumption, serving size, and calcium level of the various foods that were allocated to each food item. As much as possible, mean methods were used for assigning nutrient values to food groups because these methods have been found superior to median approaches (20). If an exact serving size was not provided on the FFQ (eg, 1 tall or 1 large), then an average serving size for "tall" or "large" was calculated from the amounts recorded on the 24-hour recalls. If outliers affected the serving size, the serving size that reflected the mode and a standard serving size was selected. If such values were not available, USDA values (19) were consulted; and if values were not available from USDA, food labels or commercial sources were used. If an exact serving size was provided on the FFQ (eg, 1 c), an average gram weight for the serving was determined based on the foods recorded on the 24-hour recalls. If such values were not available, USDA values were used; and if values were not available from USDA, food labels or commercial sources were used.

Statistical Analysis

Mean calcium intakes as estimated using FFQ1 and FFQ2 were compared using a paired *t*-test. A cube root transformation was applied in order to normalize intake distributions of the calcium values. Spearman correlations on the raw data were calculated. Pearson correlations were calculated for raw and transformed data.

The mean calcium intake of the two 24-hour recalls was compared to the second FFQ using a paired *t*-test. A cube root transformation was applied to normalize intake distributions of the calcium values. Spearman correlations on the raw data were calculated. Pearson correlations were calculated for raw, deattenuated, and transformed data. In addition, we increased the precision of these correlations by adjusting for within-person variation in calcium intakes determined from the two 24-hour recalls. Deattenuated correlation coefficients were calculated using the following formula (21):

$$r_t = r_o \{1 + [(s^2_w/s^2_b)/n]\}^{0.5}$$

where r_t is the true correlation, r_o is the observed correlation, (s^2_w/s^2_b) is the within-person variance divided by the between-person variance for calcium, and $n = 2$.

Percent agreement was calculated to assess the ability of the FFQ to reliably and accurately classify respondents into similar quartiles of calcium intake based on two administrations of the FFQ, and based on a comparison between FFQ2 and the mean of the 24-hour recalls. All statistical analyses were accomplished using the SPSS software program (version 10.0.7, 2000, SPSS Inc, Chicago, IL).

RESULTS

A total of 167 participants participated in all 4 weeks of the evaluation process. Five participants were eliminated from analysis because eight or more food items were missing on either FFQ1 or FFQ2. Table 2-1 describes the final sample of 162 participants by sex, age, and ethnicity/race.

Table 2-1. Characteristics and number of youth enrolled in a study to develop a food frequency questionnaire designed to estimate calcium intake[a]

	Male		**Female**		
Ethnicity/race	**10-13 yr**	**14-18 yr**	**10-13 yr**	**14-18 yr**	**Total**
Asian	14	17	20	18	69
Hispanic	3	8	6	12	29
White	15	10	16	23	64
Total	32	35	42	53	162

[a]Participants were recruited from Arizona (n = 19), California (n = 23), Hawaii (n = 46), Idaho (n = 11), Nevada (n = 23), and Washington (n = 40).

The goal for the completion of 24-hour recalls was to have approximately 75% of the recalls represent weekdays and 25% represent weekend days. In reality, 65% of recalls were weekdays and 35% were weekend days.

Table 2-2 presents mean daily calcium intakes measured by each FFQ and the 24-hour recalls. Mean comparisons are made for FFQ1 vs FFQ2, and for FFQ2 vs the mean of two 24-hour recalls. The ability to detect subgroup differences in calcium intake depended on the type of dietary assessment method. Using the FFQ, a significant difference in calcium intake was only observed between younger (mean calcium intake $\pm$ SD = 1,479 $\pm$ 895 mg) and older (1,200 $\pm$ 621 mg) participants based on FFQ1 (P=.021). In contrast, the calcium intake estimates based on 24-hour recalls were significantly different for males vs females (1,251 $\pm$ 697 mg vs 974 $\pm$ 438 mg, P=.002), whites vs

Asians (1,271 $\pm$ 680 mg vs 996 $\pm$ 485 mg, P=.015), and whites vs Hispanics (1,271 $\pm$ 680 mg vs 903 $\pm$ 393 mg, P=.011).

Table 2-2. Youth calcium intakes (mg) based on two administrations of a food frequency questionnaire (FFQ) compared with the mean of two 24-hour dietary recalls

Variable	FFQ1 (mean ± SD[a])	FFQ2 (mean ± SD)	Mean of both recalls (mean ± SD)
Sex			
Male (n = 67)	1,389 ± 779[d]	1,176 ± 711[d]	1,251 ± 697
Female (n = 95)	1,285 ± 764[b]	1,138 ± 531[be]	974 ± 438[e]
Age			
10-13 yr (n = 74)	1,479 ± 895[c]	1,235 ± 694[c]	1,114 ± 491
14-18 yr (n = 88)	1,200 ± 622[b]	1,086 ± 523[b]	1,066 ± 638
Ethnicity/Race			
Asian (n = 69)	1,163 ± 758	1,087 ± 666	996 ± 485
Hispanic (n = 29)	1,453 ± 968[b]	1,185 ± 643[be]	903 ± 393[e]
White (n = 64)	1,448 ± 651[c]	1,212 ± 528[c]	1,271 ± 680
Total (n = 162)	1,328 ± 769[d]	1,154 ± 610[d]	1,088 ± 575

[a]SD = standard deviation
[b-d]Means from the first administration of the FFQ (FFQ1) and the second administration of the FFQ (FFQ2) (within a line) sharing the same superscript differ significantly by [b]$P \leq .05$, [c]$P \leq .01$, and [d]$P \leq .001$.
[e]Means from FFQ2 and the mean of both recalls (within a line) sharing the same superscript differ significantly by at least $P < .05$.

Comparisons of calcium intake estimates based on repeat administrations of the FFQ are shown in Table 2-3. Calcium intake distributions for both administrations of the FFQ were approximately normal. Therefore, Spearman and Pearson correlation coefficients were similar whether calculated using raw or transformed data for the total sample as well as by gender, age, and ethnic/racial subgroups. The correlations between calcium intakes as estimated by the second FFQ vs the average of the two 24-hour dietary recalls are presented in Table 2-4. Calcium intake distributions for the 24-hour recalls were more strongly skewed than were the FFQ distributions; therefore, Pearson correlations of transformed data are generally higher than crude Pearson or Spearman correlations for the total sample as well as for sex, age, and ethnic/racial subgroups.

Percent agreement between identical quartiles of calcium intake measured by FFQ1 and FFQ2 was 49% whereas agreement within plus or minus one quartile was 85%. Percent agreement between FFQ2 and the mean of the 24-hour recalls was 42% within identical quartiles, and 76% within plus or minus one quartile.

A good match was observed between calcium food sources listed on the FFQ and calcium food sources reported during 24-hour recalls. However, the 24-hour recalls did provide some foods that could potentially contribute significant amounts of calcium to the diet that were not included on the FFQ. These foods were oranges, pesto sauce, Alfredo sauce, spaghetti sauce with cheese as an ingredient, frozen foods with cheese as an ingredient (eg, toaster sandwiches), and cheese sauce on foods other than vegetables (eg, cheese on pretzels, meat, and pasta).

DISCUSSION

This is the first study to evaluate an FFQ to specifically measure calcium intake among adolescents from three ethnic or racial backgrounds in the United States. Our instrument performs well when compared to other tools that have been evaluated in similar studies among adolescents living in the United States (22-24). To our knowledge, Barr (22) reported on the only study to date that has tested an FFQ designed specifically to measure calcium intake among adolescents. Barr reported a correlation between repeat

Table 2-3. Correlations of calcium intake based on two administrations of a food frequency questionnaire administered to teen-aged high school students 1 month apart[a]

		Sex		Age		Ethnicity/Race		
Correlation coefficient	**Total (n = 162)**	**Male (n = 67)**	**Female (n = 95)**	**10-13 yr (n =74)**	**14-18 yr (n = 88)**	**Asian (n = 69)**	**Hispanic (n = 29)**	**White (n = 64)**
Pearson	0.69	0.76	0.63	0.67	0.71	0.77	0.81	0.46
Spearman	0.63	0.69	0.57	0.50	0.72	0.72	0.77	0.40
Pearson, transformed[b]	0.68	0.73	0.64	0.62	0.73	0.77	0.72	0.48

[a]All correlation coefficients in the table are significant at P≤.001.
[b]Transformed using cube root.

Table 2-4. Correlation coefficients for calcium intake between the results of the second administration of a food frequency questionnaire and the average of two 24-hour dietary recalls

		Sex		Age		Ethnicity/Race		
Correlation coefficient	**Total (n = 162)**	**Male (n = 67)**	**Female (n = 95)**	**10-13 yr (n =74)**	**14-18 yr (n = 88)**	**Asian (n = 69)**	**Hispanic (n = 29)**	**White (n = 64)**
Pearson	0.42**	0.51**	0.31*	0.32*	0.53**	0.48**	0.16	0.49**
Spearman	0.44**	0.55**	0.37**	0.35*	0.49**	0.53**	0.21	0.43**
Deattenuated Pearson	0.50**	0.61**	0.37**	0.38**	0.63**	0.57**	0.19	0.58**
Pearson, transformed[a]	0.45**	0.54**	0.38**	0.38**	0.50**	0.54**	0.15	0.48**
Deattenuated Pearson, transformed	0.54**	0.65**	0.45**	0.46**	0.59**	0.64**	0.18	0.57**

[a]Cube root transformation to normalize distribution of data.
*P<.01.
**P≤.001.

FFQ administrations of 0.76 and a correlation between a FFQ and 1-day food intake records of 0.59. However, the study from Barr was limited to Canadian high school students in grades 9 to 12. Another FFQ, the Youth/Adolescent Questionnaire, was designed to measure several nutrients in addition to calcium in primarily white, middle- to upperclass youth aged 9 to 18 years. Studies evaluating this instrument have shown a correlation between repeat FFQ administrations of 0.58 (23) and correlations between a FFQ and 24-hour dietary recalls of 0.44 (crude) and 0.61 (deattenuated) for estimation of calcium (24). These latter studies have numerous strengths due to large sample sizes (n = 179 for estimating correlations between repeat administrations, and n = 261 for estimating correlations between a FFQ and 24-hour dietary recalls), and multiple 24-hour recalls.

Several strengths are evident in our study. First, a standardized 24-hour recall protocol was implemented among the six participating states, thereby minimizing the effects of interviewer bias. This recall protocol was efficient and modified to accomplish the goals of the study. Second, three ethnic/racial groups were assessed for calcium intake. Few dietary assessment tools exist for multicultural audiences; thus, this FFQ is valuable in its breadth of scope. Third, foods that are unique to these three ethnic/racial groups were selected as calcium sources and included on the FFQ, increasing its applicability. Fourth, age groups were selected based on the developmental years during which a substantial decline in calcium intake occurs. Fifth, correlations between repeat FFQ administrations and correlations between the FFQ and 24-hour dietary recalls were strong for the entire sample and most subgroups. Sixth, mean calcium intakes for each of the sex, age, and ethnic/racial groups were similar to other published calcium intake data

(23-26). Finally, due to the lack of calcium reference values for foods listed on the FFQ that represent dietary intake of this multiethnic youth population sample, we used the 24-hour recall data to generate these reference values. Although this method may slightly overestimate our correlations, it is appropriate and the most accurate way of determining the usefulness of this newly created FFQ.

Despite the strengths of our study and uniqueness of this tool, some limitations do exist. First, we cannot take into account the possible influence of seasonal variation in calcium intake. Dietary assessments were conducted over a 6-month period, and sampling did not allow for consideration of this issue. Second, correlations between FFQ2 and the 24-hour dietary recalls among Hispanics are low (Table 2-4); and of the three ethnic/racial groups, Hispanics were the only group to show a significant difference in mean calcium intakes as estimated by FFQ2 vs the 24-hour recalls (Table 2-2). Whether calcium intake was underreported on the 24-hour recalls or overestimated on FFQ2 cannot be determined. Given the good match observed between calcium food sources listed on the FFQ and calcium food sources reported during 24-hour recalls, the food list is unlikely to be a source of error. There may be an issue of cultural differences in recalling and reporting food intake that is worthy of further examination. In addition, whereas the intent of the project was to recruit similar numbers of Asian, Hispanic, and white youth, Hispanic participation was low due to the limited accessibility of this population to study centers.

Because overall performance of the FFQ for the entire sample of youth was good, we believe that the FFQ is generalizable across Asian, Hispanic, and white ethnic/racial groups for estimating calcium intake. However, the utility of this instrument for Hispanic youth may need further evaluation due to the observed low correlations.

As with any frequency-based dietary survey, this FFQ is useful for ranking persons within a group on the basis of their dietary intakes. We are aware that an FFQ measuring the intake of a single nutrient may overestimate the intake of that nutrient. However, our data show similar calcium intakes when compared with other reported intakes in national and other surveys. Therefore, we believe this FFQ may be used to estimate calcium intake in clinical practice, epidemiological research, and public health interventions among Asian, Hispanic, and white adolescents living in the United States.

CONCLUSIONS

A unique dietary survey has been created to estimate calcium intake among Asian, Hispanic, and white adolescents in the United States. Although future studies evaluating this survey may be warranted in Hispanic adolescent populations, this FFQ may be used in future studies of adolescents for the assessment of calcium intake.

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CHAPTER 3

INTAKE OF CALCIUM AND CALCIUM-RICH FOODS OF YOUTH AGED 6 TO 19 YEARS LIVING IN THE UNITED STATES: A REVIEW

INTRODUCTION

Osteoporosis is a major health problem of the elderly (1). Adequate calcium intake during youth and adolescence is one of several factors that helps to maximize peak bone mass and may alleviate the burden of osteoporosis later in life (1,2). Current recommendations for calcium intake among youth and adolescents are 800 mg per day for those aged 4 to 8 years and 1,300 mg per day for those aged 9 to 18 years (3). In addition, the Food Guide Pyramid recommends that children in these age groups obtain 2-3 servings per day from the calcium-rich dairy group (4). Studies that clearly quantify calcium intake of youth from different ethnicities and ages are essential to the creation of effective nutrition interventions for the prevention of osteoporosis. This chapter reviews studies that have assessed (a) total daily intake of calcium and calcium-rich foods, (b) intake of calcium and calcium-rich foods from meals and snacks, and (c) consumption of foods that interfere with calcium intake among youth from 6 to 18 years of age living in the United States. For ease of comparison, studies that have assessed total daily intake of calcium and calcium-rich foods are grouped into three categories, namely, national and multi-state observational studies, local and statewide observational studies, and clinical trials.

TOTAL DAILY INTAKE OF CALCIUM AND CALCIUM-RICH FOODS

National and Multi-State Observational Studies

This section reviews studies that have analyzed the intake of calcium and calcium-rich foods among nationally representative samples of youth living in the United States. The strength of the following studies lies in their large sample sizes and in the nature of their sampling distributions (ie, the samples are nationally representative of youth living in the United States.). Many of the studies reviewed in this section were conducted by the United States Department of Agriculture (USDA) for the very purpose of national nutrition monitoring.

In the USDA 1987-88 Nationwide Food Consumption Survey (NFCS), Fleming and Heimbach (5) evaluated food sources and intake levels of calcium for children aged 6-19 years (n=2,127). Dietary data were collected by one 24-hour recall followed by a two-day food record. Mean calcium intakes were 1,056 mg, 808 mg, 1061 mg, and 789 mg per day for boys aged 6 to 11 years, girls aged 6 to 11 years, boys aged 12 to 18 years, and girls aged 12 to 18 years, respectively. Among girls aged 12 to 18 years, milk and milk products, milk as an ingredient, and grains contributed 56%, 21%, and 10%, respectively, of total calcium intake. These data were not presented for boys and younger girls. Calcium intake was 495 mg/1,000 kcal for milk drinkers and 275 mg/1,000 kcal for nonusers of fluid milk. The investigators concluded that if Americans, particularly women, are to consume adequate calcium, they must increase milk consumption. They suggested fortification of foods and supplementation as possible alternatives.

Using data from the USDA 1989-1991 Continuing Survey of Food Intake by Individuals (CSFII), Subar et al. (6) determined major dietary sources of calcium among US children aged 6 to 18 years (n=2,901). Dietary data were examined from a single 24-hour recall. The rank order of foods contributing the most calcium to the diet were milk, cheese, yeast bread, ice cream/sherbet/frozen yogurt, cakes/cookies/quick breads/donuts, pancake/waffles/French toast, ready-to-eat cereal, and fruit drinks. Rank order of these foods did not differ by age group (6 to 11 versus 12 to 18) or sex. Milk supplied approximately 53.6%, 46.1%, and 43.4% of calcium intake for all children aged 6 to 11 years, males aged 12 to 18 years, and females aged 12 to 18 years, respectively; cheese contributed 13.2%, 16.5%, and 18.9% of calcium, respectively; yeast bread contributed 13.2%, 16.5%, and 18.9% of calcium, respectively; and ice cream/sherbet/frozen yogurt contributed 2.9%, 3.8%, and 2.9% of calcium, respectively. Two notable trends are that milk intake decreased with age and cheese intake increased with age.

Using a similar dataset from the USDA 1989-1991 CSFII, Muñoz et al. (7) determined mean daily intakes from the dairy group as defined by the Food Guide Pyramid for children aged 6 to 19 years. Dietary analysis included a single 24-hour recall followed by a 2-day food record. The average number of servings (mean ± standard error) from the dairy group were 2.2 ± 0.1, 2.4 ± 0.1, 2.1 ± 0.1, and 1.7 ± 0.1 servings per day for boys aged 6 to 11 years, boys aged 12 to 19 years, girls aged 6 to 11 years, and girls aged 12 to 19 years, respectively. Mean servings of dairy for these youth were adequate, except for girls aged 12 to 19 years. The percentages (mean ± standard error) of children meeting the recommendation for dairy intake over three consecutive days were 40.6 ± .03, 48.9 ± .02, 31.5 ± .04, and 21.7 ± .03 for boys aged 6 to 11 years, boys aged 12 to 19 years, girls aged 6 to 11 years, and girls aged 12 to 19 years, respectively. These percentages suggest that girls, especially older girls, are at risk for low dairy intake.

Another survey showing inadequate calcium intake among youth includes the General Mills Dietary Intake Study, which is a continuous survey of the American population's food and nutrient consumption. Albertson et al. (8) used data from this survey to estimate dietary calcium intake and calcium-rich food sources for a nationally representative sample of females aged 11 to 18 years. The survey included four separate samples collected during 1980-82, 1983-85, 1986-88, and 1990-92. Each participant completed a food diary for 14 consecutive days. Tables 3-1 to 3-5 describe the sample distribution and estimated calcium and milk intakes. These data indicate that many adolescent females fail to consume adequate calcium, and temporal trends indicate that calcium and milk consumption have been decreasing in recent years.

Table 3-1. Sample distribution of females who participated in the General Mills Dietary Intake Study

Age (Years)	1980-82	1983-85	1986-88	1990-92
11-12	146	144	112	73
13-14	166	138	120	109
15-18	292	272	205	169

Table 3-2. Mean daily calcium intake of females who participated in the General Mills Dietary Intake Study

	Mean daily calcium intake (mg)			
Age (Years)	1980-82	1983-85	1986-88	1990-92
11-12	811	814	837	781
13-14	761	791	782	751
15-18	677	669	668	602

Table 3-3. Mean daily fluid milk consumption of females who participated in the General Mills Dietary Intake Study

	Mean daily fluid milk consumption (g)			
Age (Years)	**1980-82**	**1983-85**	**1986-88**	**1990-92**
11-12	304	288	283	280
13-14	273	245	230	255
15-18	214	204	175	169

Table 3-4. Percentage of mean daily calcium contributed by milk products of females who participated in the General Mills Dietary Intake Study

	Percentage of mean daily calcium			
Age (Years)	**1980-82**	**1983-85**	**1986-88**	**1990-92**
11-12	61	60	58	53
13-14	60	55	55	51
15-18	57	53	50	44

Table 3-5. Percentage of mean daily calcium contributed by fluid milk of females who participated in the General Mills Dietary Intake Study

	Percentage of mean daily calcium			
Age (Years)	**1980-82**	**1983-85**	**1986-88**	**1990-92**
11-12	45	43	41	44
13-14	42	38	36	42
15-18	38	37	32	34

The School Nutrition Dietary Assessment Study (9,10) was designed to examine the dietary intakes of students on school days only. The sample included 3,352 students in grades 1 to 12 from 329 schools across the United States during the months of February through May 1992. All students were personally interviewed using a 24-hour dietary recall. Students in grades 1 to 2 (approximately 6 to 8 years old) were interviewed alone, and at a later time on the same day, they were interviewed with a parent or guardian in order to increase accuracy of their recalls. Average calcium intake for children between 6 to 10 years of age was 1,072 mg per day. Calcium intakes for males aged 11 to 14 years and for males aged 15 to18 years were 1,380 mg and 1,512 mg, respectively. Calcium intakes for females aged 11 to14 years and females aged 15 to

18 years were 1,044 mg and 960 mg, respectively. Evidence from this study suggests that adolescent females are the group at greatest risk of calcium intakes below the Dietary Reference Intakes.

Cavadini et al. (11) assessed food and nutrient intakes of US adolescents from 1965 to 1996. The sample included adolescents aged 11 to 18 years, who had participated in one of four USDA dietary surveys. The surveys included the 1965 NFCS, the 1977-78 NFCS, the 1989-91 CSFII, and the 1994-96 CSFII. Diets of 12,498 adolescents were analyzed. Mean calcium intake, for both sexes combined, gradually declined from 1,100 mg per day in the first survey to 960 mg per day in the last survey. Milk consumption for boys gradually decreased from 1,181 grams per day in 1965 to 746 grams per day in 1994-96. Similarly, milk consumption for girls decreased from 848 to 481 grams per day. The investigators concluded that girls are especially susceptible to low milk and calcium consumption, which have been decreasing over time.

Using data from the USDA 1989-1991 CSFII and 1994 CSFII, Kennedy and Powell (12) assessed milk and calcium intakes of children (n=1,843). Table 3-6 describes mean calcium intakes by age and sex for each of the surveys. These data suggest that adolescent girls are at the greatest risk of low calcium intake. The authors also found an inverse relationship between whole milk consumption and household income for all age groups combined, which implies that children with lower household incomes are more likely to consume whole milk.

Table 3-6. Average 1-day calcium intakes of children in 1989-1991 (n=832) and 1994 (n=1,011)

	Mean daily calcium intake (mg)	
Gender/Age (Years)	**1989-1991**	**1994**
Boys/6-11	854	914
Girls/6-11	824	820
Boys/12-18	1045	1134
Girls/12-18	775	829

Ballew et al. (13) assessed data obtained from the USDA 1994-96 CSFII. The sample included 2,270 boys and girls aged 6 to 18 years. Seventy-six percent of boys aged 6 to 11 years, 72% of girls aged 6 to 11 years, 63% of boys aged 12 to 18 years, and 49% of girls aged 12 to 18 years consumed milk on the day of the dietary recall. Median intakes for younger boys, younger girls, adolescent boys, and adolescent girls were 12 ounces, 11 ounces, 15 ounces, and 8 ounces per day, respectively. These data show that adolescent females are at the greatest risk of low consumption of milk.

Dwyer et al. (14) analyzed data from the Third Child and Adolescent Trial for Cardiovascular Health (CATCH) tracking study. The sample included 1,532 eighth graders living in California, Louisiana, Minnesota, and Texas, who had participated in the original CATCH intervention trial during grades 3 and 5. The original CATCH trial promoted lower intakes of total fat, saturated fat, and sodium, higher levels of physical activity, and decreased smoking. Vitamins and minerals were not a focus of the intervention. Although the original CATCH study was an intervention trial to improve cardiovascular health among third and fifth graders, the CATCH tracking study was cross-sectional and observational. Dietary assessment for the CATCH tracking study included a single 24-hour dietary recall during the spring of 1997. Recalls reflected weekday intakes only. Subjects were grouped as supplement users (n = 265) or supplement nonusers (n = 1,217). Intake of calcium from food only was 1,290 ± 60 mg per day for supplement users and 1,095 ± 19 mg per day for supplement nonusers. Total calcium intake (food plus supplements) for supplement users was 1,413 ± 59 mg per day. Results were not reported by sex or ethnicity.

Local and Statewide Observational Studies

This section reviews studies that have analyzed the intake of calcium and calcium-rich foods among statewide and local samples of youth living in the United States. Although the samples are not representative of all youth living in the United States, these studies provide valuable insights into calcium intakes for specific populations of youth living in the United States.

Chan (15) studied dietary calcium and bone mineral status of 164 white boys and girls aged 2 to 16 years living in Utah. A 2-day dietary history was completed on two separate occasions during a 3 month period for each child. Calcium intakes (mean ± standard deviation) were 1,075 ± 368 mg, 966 ± 361 mg, 1,179 ± 485 mg, and 925 ± 524 mg per day for children aged 6 to 8, 9 to 11 years, 12 to 14 years, and 15 to 16 years, respectively. The investigator reported that adolescent girls had the lowest calcium intakes, but the data were not provided. Chan did not indicate whether calcium intake included dietary supplements.

Sentipal et al. (16) examined the relationship between calcium intake and vertebral bone mineral density for white females aged 8 to 18 years living in Ohio. Dietary intake was assessed by using 4-day food records, which included three weekdays and one weekend day. Girls were grouped by Tanner Sexual Maturity Ratings (SMRs), which were based on pubertal breast development. Each group had approximately 10 subjects. Average ages for girls classified as Tanner SMR 1, 2, 3, 4, and 5 were 9 years, 10 years, 12 years, 13 years, and 15 years, respectively. Calcium intakes (mean ± standard deviation) for girls classified as Tanner SMR 1, 2, 3, 4, and 5 were 1,040 ± 110 mg, 1,060 ± 120 mg, 1,090 ± 160 mg, 920 ± 100 mg, and 960 ± 90 mg, respectively. The researchers found that calcium intake is a significant predictor of vertebral bone mineral density, and they concluded that calcium intakes for all groups of girls were too low. However, they did not clarify whether calcium intake included dietary supplements.

Rubin et al. (17) examined the relationship between several physical and lifestyle factors to bone mineral density of the spine in 299 white boys and girls aged 6 to 18 years living in Connecticut. They used a prospective four-day food record to assess dietary calcium. The investigators did not state whether dietary supplements were included in the analysis. Calcium intakes were 1,090 mg, 1,220 mg, 932 mg, and 947 mg per day for boys younger than 11 years, boys 11 years or older, girls younger than 11 years, and girls 11 years or older, respectively. These data are consistent with the national studies showing a lower intake of calcium among girls than boys, especially during the adolescent years.

Wang et al. (18) used the National Cancer Institute food frequency questionnaire (19) to assess intakes of foods and nutrients relevant to bone health in male and female subjects between the ages of 9 and 25 years. The final sample of 359 subjects included a relatively even distribution of males and females and an approximately equal number of Asians, blacks, Hispanics, and whites. Calcium intakes (mean ± standard deviation) for Asian, black, Hispanic, and white females were 760 ± 448 mg, 761 ± 462 mg, 992 ± 703 mg, 975 ± 468 mg, respectively. Calcium intakes (mean ± standard deviation) for Asian, black, Hispanic, and white males were 820 ± 428 mg, 1,085 ± 600 mg, 1,282 ± 747 mg, and 1,331 ± 535 mg, respectively. No differences in calcium intake were observed among female ethnic/racial groups. Calcium intakes for Asian males were significantly less than calcium intakes for Hispanics and whites. Comparisons between males and females were not done. Asian and black females tended to have lower ratios of calcium to energy, calcium to protein, and calcium to phosphorus compared to Hispanic and white females. In addition, Asian and black males tended to have lower ratios of calcium to energy, calcium to protein, and calcium to phosphorus compared to Hispanic and white males.

Individuals who consumed dairy products more than two times per day were classified as persons with a high intake of dairy products, and those who consumed dairy products two times or less per day were classified as persons with a low intake of dairy products. Among individuals who consumed a high intake of dairy products, 65% to 80% of the calcium intake came from dairy products. Blacks were most likely and whites were least likely to consume high fat dairy products. Among individuals who had a low intake of dairy products, about 50% of the calcium intake came from dairy products. A greater proportion of calcium came from high fat dairy products among all ethnicities of males and black and Hispanic females. Breads and cereals contributed more calcium than other nondairy sources among those who had a low intake of dairy products, especially Asians and Hispanics. Weaknesses of the study include the lack of assessing socioeconomic status, and the use of a food frequency questionnaire that was not validated for different ethnicities.

Harel et al. (20) assessed calcium intake of 1,117 boys and girls attending ninth grade in Rhode Island. Dietary assessment was determined using a 24-hour dietary recall of the previous day (weekday). Dietary supplements were included in the analysis. Calcium intake (mean ± standard error) was 536 ± 19 mg per day for girls and 681 ± 28 mg per day for boys. The difference between intake of boys and girls was statistically significant. Calcium density (mean ± standard error) was 429 ± 13 mg per 1,000 kcal for girls and 458 ± 13 mg per 1,000 kcal for boys. The difference was not statistically significant. Mean calcium intakes in this study were lower than calcium intakes reported in the other studies reviewed in this chapter. Unfortunately, the authors do not provide any detail on the methodology of their 24-hour dietary recalls; therefore, it is possible that poorly administered recalls resulted in many missing foods. However, another possibility is that adolescents in this area of Rhode Island may consume less calcium than adolescents in most other areas of the United States. Despite these caveats, the results are consistent with most other studies in that girls consume less calcium than boys. Because there is not a significant difference in calcium density between boys and girls, the data also suggest that calcium intake is higher among boys than girls because they consume more food.

Brady et al. (21) assessed the number of servings consumed from the Food Guide Pyramid among 110 African Americans and whites aged 7 to 14 years living in Alabama. A 3-pass, 24-hour recall was used for dietary assessment. Average serving intakes (mean ± standard error) from the dairy group were 1.2 ± 0.1, 1.1 ± 0.1, 1.4 ± 0.1, and 0.9 ± 0.1 servings per day for boys, girls, whites, and African Americans, respectively. Average daily servings from the dairy group in this sample of children are well below the guidelines of the Food Guide Pyramid (4).

Clinical Trials

Although the main purpose of clinical trials with calcium are to determine the effect of calcium intake on bone mineral status or other biological indices, calcium intake of the control group and baseline calcium intake of the experimental and control groups provide reasonable estimates of calcium intake in the target population. The following four clinical trials provide additional information on calcium intake in youth across the United States. The data are similar to that found in the national, statewide, and local observational studies previously mentioned.

Johnston et al. (22) conducted a 3-year, double-blind, placebo-controlled trial to determine the effect of calcium supplementation on bone mineral density in 70 pairs of white identical twins living in Indiana. Their age at baseline ranged from 6 to 14 years and their average age was 10 ± 2 years (mean ± standard deviation). Baseline calcium intakes were determined by prospective three-day food records. Baseline calcium intakes (mean ± standard deviation) were 874 ± 220 mg for girls and 990 ± 155 mg per day for boys. The authors did not state whether baseline calcium intake included dietary supplements.

Another group of researchers (23) conducted a randomized, double-blind, placebo-controlled trial to determine the effect of calcium supplementation on bone mineral density in 94 premenarchal white girls living in Pennsylvania. Their average age was 11.9 ± 0.5 years (mean ± standard deviation). Prospective three-day dietary records were assessed at baseline and every six months over an 18-month period. Dietary calcium intakes were 935 ± 258 mg per day for the placebo group and 1,016 ± 274 mg per day for the calcium group (calcium supplement used in intervention not included).

Andon et al. (24) reported on a clinical trial to determine the effects of calcium citrate malate on bone mineral content of premenarchal white girls living in Ohio and Pennsylvania. Average age (mean ± standard deviation) was 11.3 ± 0.8 years. Three-day prospective food records were used to assess calcium intake. Calcium intake at enrollment was 884 ± 290 mg per day for the placebo group and 884 ± 297 mg per day for the calcium group (calcium supplement used in intervention not included).

Chan et al. (25) conducted a randomized, 1-year, clinical trial to determine the effects of milk on bone and body composition in 48 white girls aged 9 to 13 years living in Utah. Only girls who were classified as Tanner SMR 2 qualified for the study. A three-day dietary history was used to assess calcium intake at baseline and every three months for the duration of the study. The researchers reported that calcium intakes did not differ between the control group and the dairy group at baseline, but data were not provided. Calcium intake for the control group (mean ± standard deviation) was 728 ± 321 mg per day. The investigators did not state whether dietary supplements were included in the analysis.

INTAKE OF CALCIUM FROM MEALS AND SNACKS

The previous sections have demonstrated that total daily calcium intake among youth is below recommended levels, especially among adolescent girls. However, further analysis is needed to assess what particular aspects of their diets are low or high in calcium. Analyzing the intake of calcium and calcium-rich foods from meals and snacks provides a practical breakdown of total daily calcium intake that can be applied in nutrition education and intervention.

Bigler-Doughten and Jenkins (26) examined data from the USDA 1977-78 NFCS to determine the nutrient density of meals and snacks for adolescents aged 11 to 18 years. Table 3-7 shows the calcium density from meals and snacks. Calcium densities of meals and snacks were not significantly different.

Table 3-7
Mean calcium (mg) intake per 1,000 kcal from meals and snacks for adolescents

	Boys		**Girls**	
	11-14 years	**15-18 years**	**11-14 years**	**15-18 years**
Calcium from meals	477	444	464	436
Calcium from snacks	459	459	399	426

Ezell et al. (27) analyzed the contribution of snacks to the nutrient intake of 225 high school adolescents living in eastern Tennessee. The number of boys and girls was about equal, and 94% of the participants were white. Dietary assessment included one 24-hour food record. Table 3-8 describes the calcium content of morning, afternoon, evening, and total day's snacks. The investigators also determined where the snacks were obtained and the types of foods eaten during each snack occasion. Morning snacks were mainly obtained from vending machines and school stores, and the most common foods were candies, carbonated beverages, salty snacks, and desserts. Afternoon and evening snacks were mainly obtained from home, and the most common foods were carbonated beverages, breads and cereals, milk products, and desserts. The investigators suggested that morning snacks were nutritionally inferior to afternoon and evening snacks because of the limited availability of healthful snacks at school and the positive influence of parents or guardians at home.

McCoy et al. (28) obtained data on the nutrient density of meals and snacks of 1,224 black and white girls aged 12-16 years living in eight southern states. Dietary assessment included two 24-hour recalls during the period of mid-February to mid-May 1981. Meals provided a mean of 439 mg calcium per 1,000 kcal, and snacks provided 308 mg calcium per 1,000 kcal. Whites consumed an average of 335 mg calcium per 1,000 kcal from snacks, and blacks consumed 271 mg calcium per 1,000 kcal. The investigators conclude that efforts to improve the dietary intake of adolescent girls should include education in choosing more healthful snacks.

Table 3-8
Mean calcium (mg) content of morning, afternoon, evening, and total day's snacks by adolescent boys and girls

	Snack occasion			
	Morning	**Afternoon**	**Evening**	**Total day**
Calcium for boys	109 ± 18[a]	179 ± 25	243 ± 28	337 ± 32
Calcium for girls	54 ± 17	104 ± 25	150 ± 29	187 ± 32

[a]Mean ± standard error

Siega-Riz et al. (29) examined data from the USDA 1989-91 CSFII to assess the quality of diets based on meal patterns. Data were gathered from three consecutive days of dietary intake (one 24-hour recall and two 1-day food records) for 1,310 adolescents aged 11 to 18 years. Adolescents were placed in one of three meal pattern categories regardless of the number of snacks they consumed. Individuals with a "consistent meal pattern" consumed at least two or three meals on all three days. Those with a "moderately consistent meal pattern" had at least two or three meals on two of the three days, and those with an "inconsistent meal pattern" consumed only one meal on all three days. Table 3-9 describes the mean calcium intake for each of the three categories of meal patterns. The researchers concluded that adolescents who follow a meal pattern of at least two meals with or without snacks per day on a consistent basis consume more nutrient dense diets.

Table 3-9. Mean calcium intake per day of female adolescents in the 1989-91 CSFII by meal pattern consumption

Type of meal pattern[a]	Number of subjects	Calcium intake (mg)
Consistent	538	1,072
Moderately consistent	726	856
Inconsistent	46	781

[a]See text for explanation of types of meal patterns

Cross et al. (30) studied snacking patterns of 290 fifth and sixth graders living in California, Georgia, Missouri, and New Jersey. The data were collected through a self-administered questionnaire specifically designed to study snacking patterns. The most common foods consumed during morning snacks were sweets (28.4%), meal-type items (21.4%), fruit (20.5%), baked goods (14.4%), dairy (9.3%), and salty/crunchy (5.6%). The most common foods eaten during afternoon snacks were sweets (23.8%), meal-type items (20.6%), salty/crunchy foods (18.9%), dairy (13.5%), baked goods (11.0%), and fruit (10.0%). The most common foods consumed during evening snacks were dairy (23.8%), sweets (19.1%), salty/crunchy foods (16.0%), meal-type items (15.6%), fruit (13.3%), and baked goods (10.9%). These data indicate that dairy products are more commonly consumed during evening snacks.

Devaney et al. (10) examined data from the School Nutrition Dietary Assessment Study to assess nutrient intakes at lunch for those who participated in the United States National School Lunch Program (NSLP) during the months of February to May of 1992. NSLP participants were identified as those students who consumed food from their school cafeteria and met at least three of five required meal pattern components (ie, entrée, milk, vegetable/fruit, bread/grain, and miscellaneous). Nutrient analysis of lunch intakes of NSLP participants included foods, which were consumed during lunch by NSLP participants, but were not a part of the NSLP menu. Average calcium intake at lunch for children between 6 to 10 years of age was 392 mg per day. Calcium intakes at lunch for males aged 11 to 14 years and for males aged 15 to 18 years were 480 mg and 552 mg, respectively. Calcium intakes at lunch for females aged 11 to 14 years and females aged 15 to 18 years were both 396 mg. These data indicate that NSLP participants consume 30% or more of the RDA for calcium from lunch.

Gordon et al. (31) analyzed data from the School Nutrition Dietary Assessment Study to compare nutrient intakes at breakfast and lunch for participants and nonparticipants of the School Breakfast Program (SBP) and the NSLP. Participants of the SBP consumed 38% of the RDA for calcium during breakfast and nonparticipants consumed 29%. Twenty-four-hour calcium intake for participants was 124% of the RDA, and for nonparticipants, calcium intake was 114% of the RDA. Participants of the NSLP consumed 43% of the RDA for calcium during lunch and nonparticipants consumed 25%. Twenty-four-hour calcium intakes for participants and nonparticipants were 124% and 105% of the RDA, respectively. Data by sex and age were not provided.

Jahns et al. (32) examined data from the 1977-78 NFCS, the 1989-91 CSFII, and the 1994-96 CSFII, which included a total sample of 21,236 children aged 2 to 18 years. Table 3-10 describes calcium density per 1,000 kcal for ages 6 to 11 years and for ages 12 to 18 years. The data show a decreasing trend in the density of calcium intake over the periods.

Table 3-10. Calcium density (mg/1,000 kcal) of meals and snacks by age group 1977 NFCS, 1989 CSFII, and 1996 CSFII

	Ages 6-11 years		**Ages 12-18 years**	
	Meals	**Snacks**	**Meals**	**Snacks**
Calcium intake 1977	536 ± 7[a]	504 ± 11	484 ± 5	476 ± 9
Calcium intake 1989	533 ± 9	425 ± 19	470 ± 10	457 ± 31
Calcium intake 1996	511 ± 7	400 ± 7.1	433 ± 6	380 ± 7

[a]Mean ± standard error

FOODS THAT MAY INTERFERE WITH CALCIUM INTAKE

Total daily calcium intake among youth in the United States may be decreasing over time because children are consuming more foods that interfere with calcium intake. A few studies have attempted to address the effects of carbonated soft drinks on milk and calcium intake. Four of those studies are reviewed here. Few studies adequately address other potential foods that interfere with calcium intake such as juice, fruit-flavored drinks, sports drinks, coffee, and tea.

Using data obtained from the USDA 1994 CSFII, Harnack et al. (33) examined the nutritional consequences of consuming carbonated soft drinks among children and adolescents living in the United States. The sample included 557 children aged 6 to 12 years and 423 adolescents aged 13 to 18 years. Calcium intake was measured by level of soft drink consumption. The three categories of soft drink consumption for the younger group were nonconsumer, 0.1 to 8.9 ounces per day, and 9.0 or more ounces per day. Calcium intakes for these groups were 846 ± 30 mg, 751 ± 30 mg, and 671 ± 40 mg per day, respectively. Categories of soft drink consumption for adolescents were nonconsumer, 0.1 to 12.9 ounces per day, 13.0 to 25.9 ounces per day, and 26.0 or more ounces per day. Calcium intakes for these groups were 820 ± 49 mg, 804 ± 41 mg, 652 ± 43 mg, and 636 ± 50 mg per day, respectively. For both age groups, those who were in the highest category of soft drink consumption were more likely to consume less than eight ounces of milk per day compared to nonconsumers of soft drinks. The investigators concluded that soft drink consumption is inversely correlated to milk and calcium intake. They suggested that two possible interpretations of the data are that soft drinks displace milk (cause-and-effect relationship), or youth who do not like milk will drink soft drinks instead (simple correlation).

Cavadini et al. (11) assessed food and nutrient intakes of US adolescents from 1965 to 1996. They found that carbonated soft drink consumption among boys has increased from 379 grams per day in 1965 to 1,102 grams per day in 1994-96. During the same period, soft drink consumption for girls has increased from 319 to 773 grams per day. Milk consumption for both genders decreased during this time. The authors concluded that soft drinks may be replacing milk, and the greatest concern is for girls.

Ballew et al. (13) assessed interrelationships between beverage choices and nutrient intakes. Their data were obtained from the 1994-1996 USDA CSFII. They determined that each ounce of milk consumed increased the likelihood of achieving the recommended calcium intake by 35% for children aged 6 to 11 years and by 25% for adolescents aged 12 to 17 years. On the other hand, each ounce of carbonated soft drink consumed decreased the likelihood of achieving the recommended calcium intake by 3% for children aged 6 to 11 years and by 1% for adolescents. Median intake of carbonated soft drinks for younger boys, younger girls, adolescent boys, and adolescent girls was 13 ounces, 12 ounces, 24 ounces, and 16 ounces per day, respectively. Milk intake was not significantly correlated with consumption of juice, coffee, or tea for all children. A very modest, negative correlation existed between milk and fruit juice consumption for children aged 6 to 11 years. The researchers concluded that there is a modest, inverse relationship between soft drink consumption and milk intake. A cause-and-effect relationship could not be established.

Ward et al. (34) analyzed food choices of 513 third-grade students living in Texas. Children completed a food record the day before their scheduled 24-hour dietary recall interview. An interviewer used the food record to increase the accuracy of the recall. The researchers compiled a list of the 10 most frequently eaten foods from each meal. A food list from all snacks combined was also made. Milk was a common food for breakfast, lunch, and dinner, but not for snacks. Cheese was a common food for lunch, dinner, and snacks. Carbonated soft drinks were a common food for dinner and snacks. Carbonated soft drinks were consumed more frequently than milk during dinner. A limitation of the study is that the food lists did not address portion size. These data suggest that children may need to replace carbonated soft drinks at dinner and snacks with milk.

CONCLUSION

Calcium intake among older children and adolescents has been declining over the past 30 years. Adolescent girls are at the greatest risk of inadequate calcium intake. Calcium density of snacks is generally lower than calcium density of meals. Afternoon and evening snacks tend to be more calcium dense than morning snacks. Snacks obtained at home tend to be more calcium dense than snacks obtained away from home. There is an inverse relationship between the consumption of carbonated soft drinks (CSD) and calcium intake. Intakes of other beverages, including water, are not as thoroughly assessed as are intakes of CSD. Few studies assess the location of where calcium-rich foods or foods that may interfere with calcium intake are obtained. Most of the detailed analyses are done from national studies. More regional or statewide studies need to be done. There is a need for more detailed analyses at both national and regional levels.

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CHAPTER 4

INTAKE OF CALCIUM, MILK, AND NON-MILK BEVERAGES OF HISPANIC AND NON-HISPANIC WHITE YOUTH IN UTAH

Abstract

Objective To assess calcium, milk, and non-milk beverage intakes of Hispanic and non-Hispanic white youth living in Utah.

Design Cross-sectional dietary data were examined from 24-hour dietary recalls collected from October 1998 to December 2000.

Subjects/Setting A convenience sample of 188 Hispanic and non-Hispanic white youth ages 10 to 11 and 15 to 18 years living in Utah was selected.

Statistical Analysis Mean calcium, energy, and calcium density intakes were calculated for the entire sample and by age group, sex, ethnicity, education, season of the year, and the day of the week that the food was consumed and were compared using t-tests and ANOVA. Calcium intake for the entire sample by meal type and snacks was also assessed. Total beverage and total fluid milk intakes were calculated for the entire sample and by age group, sex, and ethnicity. Percent of total beverage intake by beverage subtype and location of beverage procurement were calculated.

Results Overall mean calcium intake was 1,123 mg/day. Calcium intake differed between males and females (1,225 ± 563 mg and 1,029 ± 513 mg, P=.037). Calcium intake was not significantly different by age group, ethnicity, day of week, or season of the year. Calcium intake by breakfast, lunch, dinner, and total daily snacks did not differ significantly. Calcium intake was highest among youth who had at least one caretaker

with a master's degree or higher. Overall mean calcium density was 52.7 ± 19.7 mg/100 kcal. Calcium density differed between children aged 10 to 11 years and 15 to 18 years (56.0 ± 19.8 mg/100 kcal and 49.5 ± 19.1 mg/100 kcal, P=.0046) and between weekdays and weekend days (55.0 ± 20.0 mg/100 kcal and 46.1 ± 17.1 mg/100 kcal, P=.008). Calcium density did not vary by sex, ethnicity, or education. Overall mean beverage intake was 1,853 ± 1,195 g per day. Total beverage intake differed for children aged 10 to 11 years vs 15 to 18 years (1,513 ± 855 g vs 2,185 ± 1,378 g, P<.001), for males vs females (2,223 ± 1,402 g vs 1,506 ± 828 g, P<.001), and for Hispanics vs non-Hispanic whites (1,915 ± 932 g vs 1,814 ± 1,334 g, P<.05). Overall mean fluid milk intake was 396 ± 358 g per day. Fluid milk consumption did not vary by age group, sex, or ethnicity. For the overall sample, water provided the largest percentage of total beverage intake (41.5%). Fluid milk was 21.4% of the total beverage intake. Greater than 95% of fluid milk came from home or school. Of the total fluid milk consumed by Hispanics, 37.5% was whole milk, and for non-Hispanic whites, whole milk was 6.3% of the total fluid milk consumption.

Conclusions Mean calcium intake and fluid milk consumption in Utah children aged 10 to 11 years and 15 to 18 years are higher than the national average, but calcium intake is still below recommended levels. Substitution of fluid milk for water and soft drinks at home and away from home may help to increase milk and calcium intake. Excessive consumption of whole milk among Hispanics may need to be addressed. Some youth may perceive low-fat milk as watery; therefore, low-fat options that replace whole milk and disguise the watery taste of low-fat milk may include low-fat, flavored milk and low-fat milk on cereal.

INTRODUCTION

Achieving and maintaining a high peak bone mass is critical to the prevention of osteoporosis in later years (1-3). Consuming sufficient calcium during youth contributes to the achievement of a high peak bone mass (4). Based on the 1997 Dietary Reference Intakes, the Adequate Intake level for calcium for youth ages 9 to 18 years is 1,300 mg per day (5). This level takes into consideration the amount of calcium needed to achieve maximal peak bone mass to prevent osteoporosis later in life. Unfortunately, youth in the United States are not consuming adequate calcium (6,7).

Proper food and beverage choices are the ideal means of obtaining higher calcium intakes (8). Milk has a positive impact on calcium intake whereas other beverages like carbonated soft drinks may have a negative impact if they displace calcium-dense foods or beverages like milk (9-15). Finally, locations where beverages are obtained may influence quality of beverage selection, and ultimately, calcium intake (12,16).

The purpose of this study was to assess the intake of calcium, milk, and non-milk beverages of Hispanic and non-Hispanic white youth living in Utah. Milk fat percentage, flavored milk, milk on cereal, and beverage procurement locations were assessed.

METHODS

We recruited 198 Hispanic and non-Hispanic white youth living in Utah between October 1998 to December 2000. Table 4-1 describes the sample and Table 4-2 describes the highest level of education achieved by the caretaker(s) of each youth. Participants were chosen from a convenience sample of 21 schools within the Alpine, Cache County, Jordan, Nebo, Ogden City, and Salt Lake City school districts. Sampling from urban and rural areas was approximately equal. Participants were required to provide written consent for data collection according to guidelines outlined by the Utah State University Institutional Review Board. A parent or guardian of each participant provided demographic information such as household size, income, education, and ethnicity. Ethnicity of the youth was based on ethnicity of the youth's biological parents. Mother's ethnicity took precedence if the ethnicity of the parents differed.

Table 4-1 Demographics and calcium intake for youth who completed one 24-hour dietary recall

	10-11 Years Old		
Sex	**Hispanic Calcium mg (n)**	**White Calcium mg (n)**	**Total Calcium mg (n)**
Male	1068 ± 509 (14)	1057 ± 422 (26)	1061 ± 448 (40)
Female	1051 ± 533 (21)	1011 ± 495 (32)	1027 ± 506 (53)
Total	1058 ± 516 (35)	1031 ± 460 (58)	1041 ± 479 (93)
	15-18 Years Old		
Sex	**Hispanic Calcium mg (n)**	**White Calcium mg (n)**	**Total Calcium mg (n)**
Male	1406 ± 487 (21)	1317 ± 693 (30)	1353 ± 612 (51)
Female	929 ± 379 (16)	1089 ± 594 (28)	1031 ± 527 (44)
Total	1199 ± 499 (37)	1207 ± 651 (58)	1204 ± 594 (95)

Table 4-2. Highest level of education achieved by the caretaker(s) of sampled youth in Utah compared to the 2000 census data for Utah

Education	**Sample Size**	**Sample Percent**	**Utah Percent***
< High School (HS)	29	15.4	12.3
HS or Vocational School	30	16.0	24.6
Some College	46	24.5	29.1
College Degree (eg, BA, BS)	44	23.4	25.8
≥ MS Degree	24	12.8	8.3
Unknown	15	8.0	0.0

*Utah data is based on 2000 Census obtained from US Census Bureau

Relatively equal numbers of participants were interviewed during each of the four seasons of the year. Each participant provided one dietary recall. Approximately 75% of the recalls were weekdays and 25% were weekend days. Because we interviewed in schools, the weekend day was always Sunday.

Collection of 24-hour dietary recalls was based on the methodology used in the Continuing Survey of Food Intakes by Individuals, 1994-1996 (CSFII) (17). A brief overview and justification of our modified CSFII methodology follows. The dietary recalls were face-to-face interviews that assessed a participant's food intake from the previous day. To improve recall accuracy, the vast majority of interviews were conducted during the morning, and a small percentage was conducted during the early afternoon. We utilized the CSFII Food Instruction Booklet in order to promote a consistent interview style among the interviewers and to increase the use of neutral probes to avoid influencing the participant's response. Food models; measuring cups and spoons; rulers; concentric circles; and various-sized bowls, glasses, cups, and plates were used to determine portion sizes.

The standard 3-pass method was used (17) with some modifications. The modified passes included the creation of a quick list of foods along with the time they were consumed, a detailed description of the foods and the amount consumed, the name of each eating occasion and the location from which the foods were obtained, and a review of the food intake. At the end of the interview, we made assessments regarding usual food intake, dieting status, vitamin and mineral supplementation, food allergies or intolerances, and alcohol consumption.

Another modification to the CSFII protocol occurred during the process of making the quick list of foods. Participants were asked to use mental imagery and chronologically recount the previous day's events and activities to help them remember where, when, and what they ate (18). Participants were allowed to skip portions of the day that they could not remember. Interviewers assessed those forgotten portions of the day after the rest of the quick list of foods was made. If at this point a participant still could not remember, the forgotten portions were assessed even later in the interview process. The modified three-pass process allowed for this to naturally occur.

A registered dietitian (JKJ) trained study interviewers according to the modified CSFII protocol. Training included reading the CSFII protocol and conducting at least five practice dietary recalls with a mock participant. The dietitian observed at least three practice interviews to assess the quality of the interviewer's technique. Follow-up training and assessments occurred at least once every three months to ensure proper interviewing techniques.

The Food Processor® computer program (version 7.6, 2000, ESHA Research, Salem, OR) was used to analyze the 24-hour dietary recalls. Each food item included a serving size, a gram weight, an energy value, a calcium value, and a calcium density value (mg calcium per 100 kcal of food). Daily calcium intake, calcium density, and calcium intake of meals and snacks were analyzed. Meals and snacks were defined by the children's self-reports. Beverages were sorted and assigned to six beverage subcategories (ie, fluid milk, juice, noncarbonated soft drinks (NCSD), carbonated soft drinks (CSD), water, and other beverages). Fluid milk was further subdivided based on fat content (ie, whole, 2%, 1%, skim, and "don't know"); as milk on cereal vs milk to drink; and as nonflavored milk vs flavored milk. Sources of milk and other beverages (ie, home, school cafeteria, restaurant, grocery or convenience store, vending machine, or other locations) were evaluated.

Statistical Analysis

Mean calcium, energy, and calcium density intakes were calculated for the entire sample and by age group, sex, ethnicity, education, season of the year, and the day of the week (weekday vs weekend day) that the food was consumed. Mean calcium, energy, and calcium density intakes were compared by subgroup using *t*-tests and ANOVA. Mean calcium, energy, and calcium density intakes for the entire sample by meal type and snacks were also calculated. The amount of each of the six beverage subcategories, ie, fluid milk, juice, NCSD, CSD, water, and other beverages, consumed, as a percentage of total beverages consumed, was calculated overall and by age, sex, ethnicity, fat content of milk, and location of where the beverages were obtained. A square root transformation was used to normalize the distributions of calcium intake, energy intake, and calcium density. A cube root transformation was used to normalize the distributions of total beverage and total milk intakes. SAS software package (release 8.02, 1999-2001) was used to analyze the data.

RESULTS

Subjects

One hundred ninety-eight youth participated in the study, and therefore, completed one 24-hour recall interview. Tables 4-1 and 4-2 describe some demographic information. Ten participants were eliminated from the analysis because of interviewer error or because energy intake was either below 500 or above 5,000 kcal per day.

Calcium Intake

Overall mean calcium intake per day was 1,123 ± 545 mg (mean calcium intake ± SD). A significant difference in calcium intake was observed between males and females (1,225 ± 563 mg and 1,029 ± 513 mg, t = 2.10, P=.037). Calcium intake did not differ between younger and older participants, nor did it differ between Hispanics and non-Hispanic whites. Table 4-3 shows the effect of the level of education of the caretakers on calcium intake of their children. Calcium intake did not vary by season of the year, nor did it differ by weekday vs weekend day. Overall mean calcium intakes for breakfast, lunch, dinner, and total daily snacks did not vary (Table 4-4).

Table 4-3. Calcium intake of older youth and adolescents in Utah according to the highest level of education achieved by their caretaker(s)

Education	**mg of Calcium (mean ± standard deviation)**
< High School	1,034 ± 463[a]
High School or Vocational School	1,063 ± 522[a]
Some College	1,176 ± 556[a,b]
College Degree (eg, BA, BS)	1,009 ± 572[a]
≥ MS Degree	1,443 ± 512[b]
Unknown	1,080 ± 541[a]

[a,b]Means with the same superscript letter are not significantly different, pairwise t-tests, Bonferroni P≤.05.

Overall mean energy intake was 2,219 ± 898 kcal per day. Males consumed more energy than females (2,561 ± 918 kcal vs 1,899 ± 754 kcal, t=4.35, P<.0001). Daily energy intake was higher among youth aged 15 to 18 years vs youth aged 10 to 11 years

(2,535 ± 986 kcal vs 1,897 ± 663 kcal, *t*=5.40, P<.0001). Table 4-5 shows the effect of the level of education of the caretakers on energy intake of their children. Daily energy intake did not differ by ethnicity, day of the week, or season of the year. Overall mean energy intake for breakfast was significantly lower than mean energy intake for lunch, dinner, or total daily snacks (Table 4-4).

Table 4-4. Calcium intake, energy intake, and calcium density of meals and snacks of older youth and adolescents in Utah

Eating Occasion	mg of Calcium (mean ± SD*)	Kcal (mean ± SD)	mg Calc/100 kcal (mean ± SD)
Breakfast	290 ± 246[a]	360 ± 299[a]	91.7 ± 53.7[a]
Lunch	259 ± 209[a]	548 ± 346[b]	50.4 ± 33.4[b]
Dinner	264 ± 254[a]	650 ± 449[b]	43.2 ± 34.3[b]
Total Daily Snacks	245 ± 311[a]	555 ± 514[b]	48.1 ± 50.8[b]

[a,b]Means within the same column with the same superscript letter are not significantly different, pairwise *t*-tests, Bonferroni P≤.05.

Table 4-5. Energy intake of older youth and adolescents in Utah according to the highest level of education achieved by their caretaker(s)

Education	mg of Calcium (mean ± standard deviation)
< High School	2,284 ± 1,085[a,b]
High School or Vocational School	2,156 ± 803[a,c,d]
Some College	2,299 ± 909[a,e]
College Degree (eg, BA, BS)	1,936 ± 806[b,c]
≥ MS Degree	2,767 ± 851[d,e]
Unknown	1,935 ± 601[b,c]

[a,b]Means with the same superscript letter are not significantly different, pairwise *t*-tests, Bonferroni P≤.05.

Overall mean calcium density among all participants was 52.7 ± 19.7 mg/100 kcal. Calcium density was higher among youth aged 10 to 11 years vs youth aged 15 to 18 years (56.0 ± 19.8 mg/100 kcal vs 49.5 ± 19.1 mg/100 kcal, *t*=2.88, P=.0046), but did not differ by sex or ethnicity. Calcium density was also higher during weekdays compared to weekend days (55.0 ± 20.0 mg/100 kcal vs 46.1 ± 17.1 mg/100 kcal, *t*=2.69, P=.008), but did not vary by season of the year or by education level of the caretakers. Overall mean calcium density for breakfast was significantly higher than mean calcium density for lunch, dinner, or total daily snacks (Table 4-4).

Milk and Non-Milk Beverage Intake

Overall mean beverage intake was 1,853 ± 1,195 g per day. Daily beverage intake was higher among youth aged 15 to 18 years vs youth aged 10 to 11 years (2,185 ± 1,378 g vs 1,513 ± 855 g, *t*=3.73, P=.0003), and among males vs females (2,223 ± 1,402 g vs 1,506 ± 828 g, *t*=3.74, P=.0003). Overall mean milk consumption was 396 ± 358 g

Table 4-6. Percentage of total beverage consumed per day by beverage subcategories within age, sex, and ethnicity categories of older youth and adolescents in Utah

Category	Milk[a]	Juice[b]	NCSD[c]	CSD[d]	Water[e]	Other[f]
Age						
10-11 yr	27.6	5.2	12.0	10.9	41.4	2.9
15-18 yr	17.1	4.3	13.8	20.1	41.5	3.1
Sex						
Male	19.6	5.4	10.9	19.6	41.1	3.4
Female	23.9	3.6	16.1	11.9	42.0	2.5
Ethnicity						
White	21.5	4.1	9.6	16.9	45.5	2.4
Hispanic	21.2	5.6	18.3	15.6	35.3	3.9
Total Sample	21.4	4.7	13.1	16.4	41.5	3.0

[a]Includes milk on cereal and milk to drink as whole milk, 2%, 1%, skim, flavored milk, reconstituted dry milk, and evaporated milk. Does not include milk in food or milk in milk-based beverages.
[b]Includes 100% juice as fresh, reconstituted frozen, canned, and bottled.
[c]NCSD = noncarbonated soft drinks; includes caloric and noncaloric fruit drinks, punches, and ades. Excludes 100% juice.
[d]CSD = carbonated soft drinks; includes caloric and noncaloric, flavored, carbonated soft drinks. Excludes carbonated water.
[e]Includes water drank separately from tap, bottle, or water fountain. Does not include water present in food.
[f]Includes tea, coffee, hot chocolate, Slim Fast, and fruit smoothies. Does not include milkshakes.

per day. Daily fluid milk intake did not differ by age group, sex, or ethnicity. Table 4-6 describes the percentage of total beverage consumed by beverage subcategories. Water contributed the largest percentage of total beverage intake for both age groups, both sexes, and both ethnic groups. Fluid milk intake contributed to approximately 20% of total beverage intake for all age, sex, and ethnicity groups. Youth consumed approximately 30% of their milk on cereal and 70% as milk to drink. Approximately 80% of milk consumed was nonflavored and 20% was flavored. All milk consumed on cereal was nonflavored. Table 4-7 describes the percent share of total fluid milk consumption by varying fat contents. The high percentage intake of whole milk (37.5%) and the low percentage intake of skim milk (1.5%) among Hispanics are noteworthy. Table 4-8 shows the percentage of beverages consumed by source location. The home provided the largest percentage of all beverage subcategories. School cafeterias were the only other major source besides home for fluid milk consumption. Home and restaurants contributed to the greatest share (62.6%) of children's CSD consumption, whereas school cafeterias provided only a minor share (3.1%).

Table 4-7. Percent share of total fluid milk consumption by fat content within age, sex, and ethnic groups of older youth and adolescents in Utah

Category	Whole milk	2% milk	1% milk	Skim milk	DK % milk[a]
Age					
10-11 yr	17.1	23.2	46.4	4.5	8.8
15-18 yr	20.2	39.9	24.7	12.8	2.4
Sex					
Male	22.4	34.8	30.1	6.4	6.3
Female	14.2	27.1	42.8	10.8	5.1
Ethnicity					
White	6.3	37.6	38.0	13.1	4.9
Hispanic	37.5	21.2	32.9	1.5	7.0
Total Sample	18.6	31.2	36.0	8.5	5.7

[a]DK = don't know

Table 4-8. Percent share of beverage consumption by source location within each beverage category for Hispanic and non-Hispanic white older youth and adolescents in Utah

Beverage	Home	School Cafeteria	Restaurant	Store	Vending Machine	Other
Milk[a]	75.5	20.3	0	0.8	0	3.4
Juice[b]	77.2	6.6	3.1	5.4	0.2	7.6
NCSD[c]	58.4	13.1	11.9	5.6	2.5	8.4
CSD[d]	33.6	3.1	29.0	14.5	9.5	10.3
Water[e]	63.7	2.7	3.9	0.1	0.2	29.4
Other[f]	61.7	0	14.7	17.3	0	6.2

[a]Includes milk on cereal and milk to drink as whole milk, 2%, 1%, skim, flavored milk, reconstituted dry milk, and evaporated milk. Does not include milk in food or milk in milk-based beverages.
[b]Includes 100% juice as fresh, reconstituted frozen, canned, and bottled.
[c]NCSD = noncarbonated soft drinks; includes caloric and noncaloric fruit drinks, punches, and ades. Excludes 100% juice.
[d]CSD = carbonated soft drinks; includes caloric and noncaloric, flavored, carbonated soft drinks. Excludes carbonated water.
[e]Includes water drank separately from tap, bottle, or water fountain. Does not include water present in food.
[f]Includes tea, coffee, hot chocolate, Slim Fast, and fruit smoothies. Does not include milkshakes.

DISCUSSION

Overall mean calcium intake (1,123 mg) of this sample was lower than the Adequate Intake (AI) level of calcium recommended for children ages 9 to 18 years (5). This study reports a calcium intake that is similar to some studies (18,19) and higher compared to others (6,7,21-23).

Females consumed less calcium than males, which concurs with the results of other studies (19,21,22,24). This difference was largely due to the higher calcium intake of older males. Females consumed less energy than males, but calcium density of males and females did not differ. These results suggest that females will have to consume more calcium dense foods than males to achieve a sufficient intake of calcium without consuming excess energy. Based on the kcal intake of females in this study, the calcium density of their diets would need to be approximately 68 mg/100 kcal rather than the present level of 55.5 mg/100 kcal to achieve the recommended level of 1,300 mg calcium per day.

Youth aged 10 to 11 years consumed more calcium dense diets than youth aged 15 to 18 years; still, both younger and older youth need to achieve even higher levels of calcium density to attain adequate levels of calcium intake. Based on energy intakes of youth in this study, the dietary calcium density would need to be approximately 68 mg/100 kcal and 51 mg/100 kcal for younger and older youth, respectively. Because calcium density was greater on weekdays than on weekend days, encouraging youth to consume more calcium dense diets on weekend days may be helpful. These results suggest that youth may increase their calcium intake by 1) not skipping breakfast, 2) eating a larger, calcium-rich breakfast, and 3) choosing calcium-rich foods not only at breakfast, but at other meals and snacks as well.

Fluid milk consumption was 396 g per day with no significant differences by age, sex, or ethnicity. Daily national averages as determined by CSFII 1994-1996, 1998 (7,9,10) were 291 g, 234 g, and 189 g for all children ages 9 to 13 years, all children ages 14 to 18 years, and girls ages 12 to 19 years, respectively. Fluid milk intake of this sample of Utah children is higher than the national average.

Table 4-6 shows that water was the greatest contributor to total beverage consumption. Fluid milk was the second largest contributor. When grouped separately, CSD and NCSD provide lower percent shares of total beverage consumption than milk, but the combination of CSD and NCSD surpasses milk and approaches the percent contribution of water. Continued encouragement of fluid milk consumption over CSD and NCSD consumption is needed. Possible methods of increasing fluid milk consumption over CSD and NCSD include encouraging youth to substitute flavored milk for CSD and NCSD (25) and to choose ready-to-eat cereal snacks that provide milk on cereal rather than snacks that do not encourage fluid milk intake.

According to national data, the percent share of total milk consumption by whole milk and by skim milk among youth aged 12 to 19 years is about 34% and 14%, respectively (7). Table 4-7 shows a high percentage intake of whole milk and a low percentage intake of skim milk among Hispanics. Encouraging the intake of lower fat milk among Hispanics may be necessary. Some individuals do not switch from whole milk to low-fat milk because they perceive low-fat milk as too watery; therefore, educating youth to replace whole milk with low-fat milk may result in lower intakes of milk. Some possible ways of decreasing whole milk consumption without decreasing milk intake are the replacement of whole milk with low-fat, flavored milk (25) or the use of milk on cereal to disguise the perceived watery flavor of low-fat milk.

Table 4-8 shows that children obtained the greatest percent share of each beverage subcategory from home. Greater than 95% of milk came from either home or the school cafeteria. National data show that for children aged 6 to 17 years, 63.7% and 14.4% of CSD are obtained from home and restaurants, respectively (12). The Utah sample has a lower percentage of CSD coming from home and a higher percentage of CSD coming from restaurants. The difference between the two samples may be due to the age group differences. Encouraging children to choose fluid milk instead of CSD or NCSD from all sources appears necessary. Because water intake is so high at home, another possible avenue to increase children's intake of fluid milk is to encourage milk instead of water for some of their home meals or snacks.

CONCLUSIONS

Mean calcium intake and fluid milk consumption in Utah children aged 10 to11 years and 15 to 18 years are higher than the national average, but calcium intake is still below the recommendation. Substitution of fluid milk for water and soft drinks at home and away from home may be practical methods to increase fluid milk consumption and calcium intake. Flavored milk may be a tasteful alternative to soft drinks. Excessive consumption of whole milk among Hispanics may need to be addressed. Because some youth may perceive low-fat milk as too watery, substitution of low-fat milk for whole milk may be difficult. To encourage the transition of consuming whole milk to consuming more low-fat, milk, some possible options are to encourage the consumption of low-fat, flavored milk and milk on cereal, which may disguise the perceived watery taste of low-fat milk.

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CHAPTER 5

SUMMARY AND CONCLUSIONS

The objective of this dissertation project was to enhance our understanding of the intake of calcium among 10- to 18-year-old Asian, Hispanic, and white youth living in the western United States. This dissertation includes reports from two studies and a review paper. The first study (Chapter 2) describes the development of a food frequency questionnaire (FFQ) to estimate calcium intake of Asian, Hispanic, and white youth aged 10 to 18 years. The review paper (Chapter 3) describes studies that have assessed intake of calcium, calcium-rich foods, and foods that may interfere with calcium intake of youth aged 6 to 18 years. The second study (Chapter 4) assesses intake of calcium, milk, and non-milk beverages of Hispanic and white youth living in Utah.

Development of a Food Frequency Questionnaire

The US Department of Agriculture's multistate project, W191, developed an FFQ designed to accurately and reliably estimate calcium intake of 10- to 18-year-old Asian, Hispanic, and white youth living in the western United States. The correlation between calcium intake estimates of the first and second administration of the FFQ, representing a measure of reliability, was 0.68 (Pearson's r) for the total sample. Correlations varied by age, sex, and ethnicity as follows: 10 to 13 years ($r=0.62$), 14 to 18 years ($r=0.73$), male ($r=0.73$), female ($r=0.64$), Asian ($r=0.77$), Hispanic ($r=0.72$), and white ($r=0.48$). The correlation between calcium intake estimates of the second FFQ and the average of the two 24-hour dietary recalls, representing a measure of accuracy, was 0.54 (deattenuated Pearson's r) for the total sample. Correlations varied by age, sex, and ethnicity as follows: 10 to 13 years (r=0.46), 14 to 18 years (r=0.59), male (r=0.65), female (r=0.45), Asian (r=0.64), Hispanic (r=0.18), and white (r=0.57). Results indicate that correlations between repeat FFQ administrations and correlations between the second FFQ and 24-hour dietary recalls were strong for the total sample and most subgroups. Hispanics were the only subgroup to show a significant difference in mean calcium intakes as estimated by the second FFQ vs the 24-hour dietary recalls. The cause of this difference is unknown and requires further investigation.

This newly developed FFQ accurately and reliably estimates calcium intake of Asian, Hispanic, and white youth aged 10 to 18 years living in the United States. One exception is that the accuracy of calcium intake of Hispanic youth is low. Further evaluation of this FFQ with Hispanic youth is needed.

Intake of Calcium and Calcium-Rich Foods of US Youth: A Review

National and regional epidemiological studies in the United States consistently demonstrate that calcium intake of youth has been declining over the past 30 years. Most studies indicate that adolescent girls are at the greatest risk of inadequate calcium intake. Some research suggests that snacks tend to be less calcium dense than meals, and snacks obtained at home tend to be more calcium dense than snacks obtained away from home.

Milk intake of youth is generally inadequate. Studies usually show an inverse relationship between the consumption of carbonated soft drinks (CSD) and milk or calcium intake. Intakes of other beverages, including water, are not as thoroughly assessed as are intakes of CSD. Few studies assess the location of where calcium-rich foods or foods that may interfere with calcium intake are obtained. Most of the detailed analyses are done from national studies. More regional or statewide studies need to be done.

Intake of Calcium, Milk, and Non-Milk Beverages of Youth in Utah

A cross-sectional study of Hispanic and white youth living in Utah was designed to estimate their intake of calcium, milk, and other beverages. Overall mean calcium intake was 1,123 mg per day. A significant difference in calcium intake between males and females (1,225 and 1,029 mg, t=2.10, P=.037) was observed. Overall mean energy intake was 2,219 kcal per day. Males consumed more energy than females (2,561 kcal vs 1,899 kcal t=4.35, P<.0001), and youth aged 15 to 18 years consumed more energy than youth aged 10 to 11 years (2,535 kcal vs 1,897 kcal, t=5.40, P<.0001). Overall mean calcium density was 52.7 mg/100 kcal. Calcium density differed between children aged 10 to 11 years and 15 to 18 years (56.0 mg/100 kcal and 46.1 mg/100 kcal, t=2.88, P=.0046).

Overall mean beverage intake was 1,853 g per day. Daily beverage intake differed for children aged 10 to 11 years vs 15 to 18 years (1,513 g vs 2,185 g, t=3.73, P=.0003) and for males vs females (2,223 g vs 1,506 g, t=3.74, P=.0003). Overall mean fluid milk consumption was 396 g per day. Milk was about 20% of total beverage intake per day. Children consumed about 30% of their milk on cereal and 70% as milk to drink. Approximately 80% of fluid milk was nonflavored and 20% was flavored. Of the total fluid milk consumed by Hispanics, 37.5% was whole and 1.5% was skim. Children's homes provided the largest percent share of all beverages including milk, juice, CSD, noncarbonated soft drinks, water, and other miscellaneous beverages. Over 95% of fluid milk was obtained from home or school cafeterias.

Mean calcium intake and fluid milk consumption in Utah children aged 10 to 11 years and 15 to 18 years are higher than the national average, but calcium intake is still below the recommended levels. Excessive consumption of whole milk among Hispanics may need to be addressed. Substitution of fluid milk for water and soft drinks at home and away from home may be practical methods to increase fluid milk consumption and calcium intake. Low-fat, flavored milk and milk on cereal may be helpful in replacing whole milk.

Conclusions

The newly developed FFQ may be used to estimate calcium intakes of Asian, Hispanic, and white youth in the United States. Accuracy of the FFQ among Hispanic youth needs to be evaluated further. Mean calcium intake and fluid milk consumption of Utah children tends to be higher than the national average, but calcium intake is still below the recommendation. Encouraging Hispanics to drink lower fat milk may be necessary. Because some individuals perceive low-fat milk as watery, replacement of whole milk with low-fat, flavored milk and milk on cereal may be helpful in disguising the perceived watery taste of low-fat milk. Substitution of fluid milk for water and soft drinks at home and away from home may help increase the consumption of milk and calcium.

APPENDICES

Appendix A. Forms for 24-Hour Recalls

ID ______________

Interviewer ______________

Date of Interview ______________

Day of Interview ______________

Time Started __________ AM
PM

Time Ended __________ AM
PM

Subject's Name ____________________

Birth Date ______________

Age __________

Sex __________

Race __________

School ____________________

TIME STARTED ____________ AM
PM

1. MAKING THE QUICK LIST

I'd like you to tell me everything you had to eat and drink all day yesterday, (DAY), from the time you got up in the morning to the time you went to bed at night. Include everything you ate and drank at home and away – even snacks, water, coffee, and alcoholic beverages.

[CHRONOLOGICALLY GO THROUGH THE PREVIOUS DAY'S ACTIVITIES.] In order to help you remember everything you had to eat and drink, I want you to also tell me what you did yesterday. Please start with the time you awoke.

[WHEN RESPONDENT STOPS LISTING NON-EATING EVENTS, ASK: What did you do next?]

[WHEN RESPONDENT MENTIONS AN EATING EVENT, ASK RESPONDENT TO STATE THE APPROXIMATE TIME OF DAY AND WHAT HE/SHE ATE OR DRANK.]

[WHEN RESPONDENT STOPS LISTING FOODS EATEN DURING AN EATING EVENT, ASK: Anything else?]

[WHEN RESPONDENT STATES THAT HE/SHE DID NOT HAVE ANYTHING ELSE TO EAT OR DRINK, ASK: What did you do next?]

2. a. DESCRIPTION OF FOOD/DRINK
   b. HOW MUCH OF THE [FOOD] DID YOU ACTUALLY (EAT/DRINK)?

[NOTE: **Q2a** AND **Q2b** ON THE 24-HOUR RECALLS FOR THE UTAH CALCIUM STUDY ARE THE SAME AS **Q4** AND **Q5** IN THE FOOD INSTRUCTION BOOKLET FOR CSFII 1994-96.]

Now I'm going to ask you for more detail about the foods and beverages you just listed. I will be using this notebook to find the specific questions I need to ask. When you remember anything else you ate or drank as we go along, please tell me.

When I ask about amounts, you can use these measuring guides in order to help you estimate how much food you ate or drank yesterday. [SHOW THE PARTICIPANT THE MEASURING CUPS AND SPOONS, THE RULER, THE THICKNESS STICKS, THE CIRCLES, THE SAMPLE GLASSES, MUGS, AND BOWLS, AND THE FOOD MODELS.]

[NOTE: AFTER COMPLETING QUESTIONS 2a AND 2b, THE INTERVIEWER SHOULD GO BACK TO THE BEGINNING OF THE DAY AND SIMULTANEOUSLY ASK QUESTIONS 3, 4, AND 5 FOR EACH FOOD ITEM UNTIL THE LAST FOOD OF THE DAY IS DISCUSSED.]

3. TIME OF EATING OCCASION

[THIS QUESTION ONLY NEEDS TO BE ASKED IF THE INTERVIEWER FORGOT TO ASK THE TIME OF DAY WHILE MAKING THE QUICK LIST OF FOODS.]

About what time did you begin to eat/drink the (FOOD)? [OR CONFIRM IF RECORDED WHEN QUICK LIST WAS DONE]

4. NAME OF EATING OCCASION [CODES ON CARD 1]

Looking at this card [CARD 1], please tell me what you would call this occasion? [OR CONFIRM IF RECORDED WHEN QUICK LIST WAS DONE]

5. LOCATION OF WHERE FOOD WAS OBTAINED [CODES ON CARD 2]

Where did you get this food? [OR CONFIRM IF RECORDED WHEN QUICK LIST WAS DONE]

6. REVIEW

Now let's see if I have everything. I'd like you to try to remember anything else you ate or drank yesterday, that you haven't already told me about, including anything you ate or drank while preparing a meal or while waiting to eat.

6a. Did you have anything to eat or drink between midnight yesterday and your (TIME) (FIRST OCCASION)?

6b. Now at (TIME) for (OCCASION) you had (FOODS), did you have anything else?

6c. Did you have anything to eat or drink between your (TIME) (OCCASION) and your (TIME) (NEXT OCCASION)?

REPEAT 6b AND 6c FOR EACH OCCASION EXCEPT LAST OCCASION. FOR LAST OCCASION, GO TO 6d.

6d. Now at (TIME) for (LAST OCCASION) you had (FOODS), did you have anything else?

6e. Did you have anything to eat or drink after your (TIME) (LAST OCCASION) but before midnight?

7. Was the amount of food that you ate yesterday about usual, less than usual, or more than usual?

USUAL	1	(Q10)
LESS THAN USUAL.	2	(Q8)
MORE THAN USUAL	3	(Q9)

8. What is the main reason the amount you ate yesterday was less than usual?

SICKNESS	01	
SHORT OF MONEY	02	
TRAVELING	03	
AT A SOCIAL OCCASION OR ON A SPECIAL DAY . . .	04	
ON VACATION	05	
TOO BUSY	06	(Q10)
NOT HUNGRY	07	
DIETING	08	
FASTING	09	
BORED OR STRESSED	10	
SOME OTHER REASON (SPECIFY) .	11	______________

9. What is the main reason the amount you ate yesterday was more than usual?

TRAVELING	1	
AT A SOCIAL OCCASION OR ON A SPECIAL DAY . . .	2	
ON VACATION	3	
VERY HUNGRY	4	
BORED OR STRESSED	5	
SOME OTHER REASON (SPECIFY) .	6	______________

10. Are you on any kind of diet either to lose weight or for some other health-related reason?

YES	1	(Q11)
NO	2	(Q12)

11. If yes to above question, what type(s) of diet(s) are you on? ____________________

____

____

12. How often, if at all, do you take any vitamin or mineral supplement in pill or liquid form? Would you say every day or almost every day, every so often, or not at all?

EVERYDAY OR ALMOST EVERY DAY	1	(Q13)
EVERY SO OFTEN	2	(Q13)
NOT AT ALL	3	(Q15)

13. Looking at this card [CARD 3], which of these types of supplements do you usually take… a multivitamin; multivitamin with iron or other minerals; or single vitamins or minerals? (CIRCLE ALL THAT APPLY)

MULTIVITAMIN	1	BRAND NAME ____________
MULTIVITAMIN WITH IRON OR OTHER MINERALS	2	BRAND NAME ____________
SINGLE VITAMINS/MINERALS . .	3	
DON' T KNOW	4	

[SINGLE VITAMINS OR MINERALS INCLUDES SMALL COMBINATIONS OF VITAMINS OR MINERALS, SUCH AS CALCIUM-IRON-MAGNESIUM, B-COMPLEX, ETC.]

IS "3" CIRCLED IN Q13?

YES . . .	1	(Q14)
NO . . .	2	(Q15)

14. Looking at this card [CARD 4], which of these single vitamins and minerals do you usually take? (CIRCLE ALL THAT APPLY)

VITAMIN A	01
VITAMIN B/B COMPLEX . . .	02
VITAMIN C	03
VITMAIN D	04
VITAMIN E	05
FOLIC ACID/FOLATE	06
CALCIUM	07
IRON	08
ZINC	09
FLUORIDE	10
CHROMIUM.	11
SELENIUM	12
SOMETHING ELSE (SPECIFY) . .	13 ____________
DON'T KNOW	14

15. Do you have any food allergies that make it necessary to avoid certain foods?

YES	1	
NO	2	(Q17)

16. What food allergies do you have? (CIRCLE ALL THAT APPLY. DO NOT STATE OR SHOW ANY EXAMPLES OF FOOD ALLERGIES.)

WHEAT	01	
COW'S MILK	02	
EGGS	03	
FISH OR SHELLFISH	04	
CORN	05	
PEANUTS	06	
OTHER NUTS	07	
SOY PRODUCTS	08	
OTHER (SPECIFY)	09	____________

17. This is a question about alcohol. No one besides us will know your answer. During the past 12 months, that is since last (NAME OF MONTH), have you consumed any alcoholic beverage like beer, wine, wine coolers, or any other alcoholic beverage?

YES	1	(Q18)
NO	2	(TIME ENDED)

18. During the past 12 months, have you consumed any:

	YES	NO	
Beer or ale	1	2	
Wine or wine coolers?	1	2	
Liquor, such as whiskey, rum, gin, or vodka, or mixed drinks containing liquor?	1	2	
Any other alcoholic beverages? (SPECIFY)	1	2	____________

THANK RESPONDENT

TIME ENDED ____________ AM
PM

DID YOU OR THE RESPONDENT HAVE DIFFICULTY WITH THIS INTAKE INTERVIEW?

YES	1
NO	2

WHAT WAS THE REASON FOR THE DIFFICULTY? ____________________

____

____

____

Q1 Quick List of Food Items √	Q1 Time (always ask) Occasion/Location (if stated)	Q3 Time	Q4 Name of Occ.	Q5 Loc.	Q2 Food/Drink and Additions	Q2a Description of Food/Drink and Ingredient Amount	Q2b How much of this (FOOD) did you actually eat/drink?

Time Began ________ AM PM Time Ended ________ AM PM Date of Interview ____________ Day of Interview ____________ ID ________

Appendix B. Calcium Food Frequency Questionnaire

WHAT YOU EAT AND DRINK

The following sections refer to the foods you ate over the past month.
If you do not know what a food is, you probably do not eat it.

For example, if you drink one cup or one carton of milk one time per week, then your answer should look like this:

Milk (1 cup or 1 carton)
- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ● 1 cup per week
- ○ 2 -6 cups per week
- ○ 1 cup per day
- ○ 2 - 3 cups per day
- ○ 4 or more cups per day

BEVERAGES

Fill in one bubble for each food item. The following statements refer to what you ate over the past month.

74. Soda pop, any type (1 can or 1 glass)
- ○ Never or less than once per month
- ○ 1 - 3 cans per month
- ○ 1 can per week
- ○ 2 - 6 cans per week
- ○ 1 can per day
- ○ 2 or more cans per day

75. Fruit flavored drink such as Hawaiian Punch,® lemonade, Kool-Aid® or other non-carbonated fruit drink (1 glass or 1 juice box)
- ○ Never or less than once per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 or more glasses per day

76. Orange juice (½ cup)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 serving per day
- ○ 2 or more servings per day

a. Is the orange juice you drink fortified with calcium?
- ○ Yes
- ○ No
- ○ Don't Know

77. Café Latte, Café Mocha, Cappuccino, or Café Au Lait (1 tall or 1 large)
- ○ Never or less than once per month
- ○ 1 - 3 drinks per month
- ○ 1 drink per week
- ○ 2 - 6 drinks per week
- ○ 1 drink per day
- ○ 2 or more drinks per day

78. Coffee or tea (1 cup)
- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 6 cups per week
- ○ 1 cup per day
- ○ 2 or more cups per day

79. Cocoa (hot chocolate) made with milk (1 cup)
- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 6 cups per week
- ○ 1 cup per day
- ○ 2 or more cups per day

DAIRY PRODUCTS

Fill in one bubble for each food item. The following statements refer to what you ate over the past month.

80. Milk to drink, white or chocolate (1 cup or 1 carton)
- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 6 cups per week
- ○ 1 cup per day
- ○ 2 - 3 cups per day
- ○ 4 or more cups per day

81. Milk on cereal (1 bowl)
- ○ Never or less than once per month
- ○ 1 - 3 bowls per month
- ○ 1 bowl per week
- ○ 2 - 4 bowls per week
- ○ 5 - 7 bowls per week
- ○ 2 or more bowls per day

82. Soy milk (1 cup)
- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 6 cups per week
- ○ 1 cup per day
- ○ 2 - 3 cups per day
- ○ 4 or more cups per day

83. Instant breakfast drink such as Carnation Instant Breakfast® (1 packet or 1 glass)
- ○ Never or less than once per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 - 3 glasses per day
- ○ 4 or more glasses per day

84. Yogurt, not frozen (1 container)
- ○ Never or less than once per month
- ○ 1 - 3 containers per month
- ○ 1 container per week
- ○ 2 - 6 containers per week
- ○ 1 container per day
- ○ 2 or more containers per day

85. Blended yogurt and juice drink or yogurt drink (1 glass or 1 large)
- ○ Never or less than once per month
- ○ 1 - 3 glasses per month
- ○ 1 glass per week
- ○ 2 - 6 glasses per week
- ○ 1 glass per day
- ○ 2 or more glasses per day

86. Pudding, custard, or flan (1 snack pack or ½ cup)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 serving per day
- ○ 2 or more servings per day

87. Frozen yogurt or ice cream (½ cup or 1 scoop or 1 bar)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 serving per day
- ○ 2 or more servings per day

88. Milk shake, malt, or frappé (1 shake, 1 malt, or 1 frappé)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 -6 servings per week
- ○ 1 serving per day
- ○ 2 or more servings per day

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89. Cheese (1 slice, 1 stick, or a 1 inch cube)

○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 -6 servings per week
○ 1 serving per day
○ 2 or more servings per day

90. Cheese spread orange-colored, such as Cheez Whiz ® (2 tablespoons)
○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 or more servings per week

91. Cottage cheese (½ cup)
○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 or more servings per week

COMBINATION FOODS

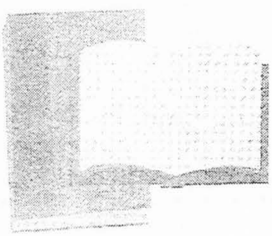
Fill in one bubble for each food item. The following statements refer to what you ate over the past month.

92. Macaroni and cheese (1 cup)
○ Never or less than once per month
○ 1 - 3 cups per month
○ 1 cup per week
○ 2 - 4 cups per week
○ 5 or more cups per week

93. Lasagna with cheese, cheese tortellini, or cheese ravioli (1 cup or 1 serving)
○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 or more servings per week

94. Nachos with cheese (6 - 8 nachos)
○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 or more servings per week

95. Hamburger or hot dog without cheese on a bun (1 hamburger or 1 hot dog)
○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 - 4 servings per week
○ 5 or more servings per week



96. Hamburger or hot dog with cheese on a bun (1 hamburger or 1 hot dog)
○ Never or less than once per month
○ 1 - 3 servings per month
○ 1 serving per week
○ 2 - 4 servings per week
○ 5 or more servings per week

97. Breakfast sandwich with cheese (1 sandwich)
○ Never or less than once per month
○ 1 - 3 sandwiches per month
○ 1 sandwich per week
○ 2 - 4 sandwiches per week
○ 5 or more sandwiches per week

98. Grilled cheese sandwich (1 sandwich)
○ Never or less than once per month
○ 1 - 3 sandwiches per month
○ 1 sandwich per week
○ 2 - 4 sandwiches per week
○ 5 or more sandwiches per week

99. Pizza (1 slice)

○ Never or less than once per month
○ 1 - 3 slices per month
○ 1 slice per week
○ 2 - 4 slices per week
○ 5 or more slices per week

100. Enchilada: beef, chicken, or pork (1 enchilada)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

101. Enchilada: cheese (1 enchilada)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

102. Bean burrito (1 burrito)

- ○ Never or less than once per month
- ○ 1 - 3 burritos per month
- ○ 1 burrito per week
- ○ 2 - 4 burritos per week
- ○ 5 or more burritos per week

103. Taco (1 taco)

- ○ Never or less than once per month
- ○ 1 - 3 tacos per month
- ○ 1 taco per week
- ○ 2 - 4 tacos per week
- ○ 5 or more tacos per week

104. Tamales (1 tamale)

- ○ Never or less than once per month
- ○ 1 - 3 tamales per month
- ○ 1 tamale per week
- ○ 2 - 4 tamales per week
- ○ 5 or more tamales per week

105. Quesadilla (1 quesadilla)

- ○ Never or less than once per month
- ○ 1 - 3 quesadillas per month
- ○ 1 quesadilla per week
- ○ 2 - 4 quesadillas per week
- ○ 5 or more quesadillas per week

106. Chile relleno (1 chile)

- ○ Never or less than once per month
- ○ 1 - 3 chiles per month
- ○ 1 chile per week
- ○ 2 - 4 chiles per week
- ○ 5 or more chiles per week

107. Soup or chowder made with milk (1 cup)

- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 4 cups per week
- ○ 5 or more cups per week

108. Stir fry vegetables, no meat (1 cup)

- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 or more cups per week

109. Stir fry shrimp and vegetables (1 cup)

- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 or more cups per week

110. Stir fry beef, pork, or chicken and vegetables (1 cup)

- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 or more cups per week

VEGETABLES, GRAINS, and NUTS

Fill in one bubble for each food item. The following statements refer to what you ate over the past month.

111. Broccoli, cooked (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

112. Broccoli, raw (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

113. Dark green leafy vegetables such as spinach, leafy greens, bok choy, or taro leaves (½ cup cooked)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

114. Carrots, cooked or raw (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

115. Kimchee or pickled cabbage (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

116. How often do you eat cheese on vegetables?

- ○ Never or less than once per month
- ○ 1 - 3 times per month
- ○ Once per week
- ○ 2 - 4 times per week
- ○ 5 or more times per week

117. How often do you eat cold cereal? (1 cup or 1 bowl)

- ○ Never or less than once per month
- ○ 1 - 3 bowls per month
- ○ 1 bowl per week
- ○ 2 - 4 bowls per week
- ○ 5 - 7 bowls per week
- ○ 2 or more bowls per day

118. What is the name of the cold cereal you eat most often?

[ ]

119. Bread, toast, or pita (1 slice or 1 pita)

- ○ Never or less than once per month
- ○ 1 slice per week
- ○ 2 - 4 slices per week
- ○ 5 - 7 slices per week
- ○ 2 - 3 slices per day
- ○ 4 or more slices per day

120. Muffin, any type (1 large muffin)

- ○ Never or less than once per month
- ○ 1 - 3 muffins per month
- ○ 1 muffin per week
- ○ 2 - 4 muffins per week
- ○ 5 or more muffins per week

121. Pancakes, waffles, or French toast (1 pancake, 1 waffle, or 1 slice)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

122. Bagel (1 bagel)

- ○ Never or less than once per month
- ○ 1 - 3 bagels per month
- ○ 1 bagel per week
- ○ 2 - 4 bagels per week
- ○ 5 or more bagels per week

123. Hominy or posole (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

124. Atole (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

125. Polenta (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

126. Miso (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

127. Corn tortilla, yellow (1 tortilla)

- ○ Never or less than once per month
- ○ 1 - 3 tortillas per month
- ○ 1 tortilla per week
- ○ 2 - 4 tortillas per week
- ○ 5 or more tortillas per week

128. Flour tortilla, white (1 tortilla)

- ○ Never or less than once per month
- ○ 1 - 3 tortillas per month
- ○ 1 tortilla per week
- ○ 2 - 4 tortillas per week
- ○ 5 or more tortillas per week

129. Poi made from taro (1 cup)

- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 4 cups per week
- ○ 5 or more cups per week

130. White rice, cooked (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

131. Mashed potatoes (1 cup)

- ○ Never or less than once per month
- ○ 1 - 3 cups per month
- ○ 1 cup per week
- ○ 2 - 4 cups per week
- ○ 5 or more cups per week

132. Whole cooked beans such as kidney, pinto, or baked beans (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

133. Adzuki bean foods such as mochi (1 piece or ½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

134. Refried beans (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

135. Soybeans, cooked (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

136. Natto or fermented soybean (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

137. Tofu (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

138. Almonds (1/3 cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 or more servings per week

SEAFOOD

Fill in one bubble for each food item. The following statements refer to what you ate over the past month.

139. Shellfish such as shrimp or scallops (½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

140. Sardines, smelts, or herring (1 serving)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

141. Salmon or chum, canned (1 serving)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

142. Mixed seafood such as poke or sushi (1 serving or ½ cup)

- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

143. Small dried fish (1 teaspoon)

- ○ Never or less than once per month
- ○ 1 - 3 teaspoons per month
- ○ 1 teaspoon per week
- ○ 2 or more teaspoons per week

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OTHER FOODS

Fill in one bubble for each food item. The following statements refer to what you ate over the past month.

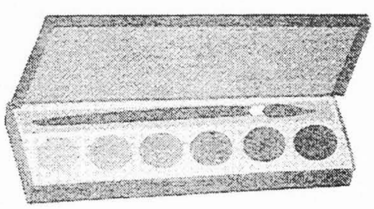
144. Cheese and crackers snack packs such as Snackables® (1 pack)
- ○ Never or less than once per month
- ○ 1 - 3 packs per month
- ○ 1 pack per week
- ○ 2 or more packs per week

145. Granola bar with chocolate (1 bar)
- ○ Never or less than once per month
- ○ 1 - 3 bars per month
- ○ 1 - 4 bars per week
- ○ 5 or more bars per week

146. NutriGrain® or NutriGrain Twist® bar (1 bar)
- ○ Never or less than once per month
- ○ 1 - 3 bars per month
- ○ 1 - 4 bars per week
- ○ 5 or more bars per week

147. Cream pie such as banana, chocolate, pumpkin, or coconut (1 slice)
- ○ Never or less than once per month
- ○ 1 - 3 slices per month
- ○ 1 slice per week
- ○ 2 or more slices per week

148. Cupcakes or cake (1 slice or 1 cupcake)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day



149. Chocolate candy bar (1 regular size bar, ½ king size bar, or 1 packet)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

150. Chocolates, chocolate kisses, or bite sized candy bars (3 - 5 pieces)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 6 servings per week
- ○ 1 or more servings per day

151. Oriental snack mix such as Arare (1¼ cup)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

152. Dry seaweed or nori (1 large sheet)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 or more servings per week

153. Oatmeal, instant (1 packet or ½ cup)
- ○ Never or less than once per month
- ○ 1 - 3 servings per month
- ○ 1 serving per week
- ○ 2 - 4 servings per week
- ○ 5 - 7 servings per week
- ○ 2 or more servings per day

SUPPLEMENTS

154. Do you now take vitamin and mineral supplements such as Flintstones® or One-A-Day®?
- ○ No (go to question number 155)
- ○ Yes

a) How many vitamin and mineral supplements do you take per week?
- ○ 2 or less pills per week
- ○ 3 - 6 pills per week
- ○ 7 - 9 pills per week
- ○ 10 or more pills per week

b) For how many years have you taken them?
- ○ 0 -1 year
- ○ 2 - 4 years
- ○ 5 - 9 years
- ○ 10 or more years

c) What brand of vitamin and mineral supplement do you take?

[ ]

- ○ Don't know

155. Do you now take a calcium supplement?
- ○ No (go to question number 156)
- ○ Yes

a) How many calcium supplements do you take per week?
- ○ 2 or less pills per week
- ○ 3 - 6 pills per week
- ○ 7 - 9 pills per week
- ○ 10 or more pills per week

b) For how many years have you taken them?
- ○ 0 -1 year
- ○ 2 - 4 years
- ○ 5 - 9 years
- ○ 10 or more years

c) What brand of calcium supplement do you take?

[ ]

- ○ Don't know

156. Do you now take a protein supplement?
- ○ No (go to question number 157)
- ○ Yes

a) How many times do you take a protein supplement per week?
- ○ 2 or less times per week
- ○ 3 - 6 times per week
- ○ 7 - 9 times per week
- ○ 10 or more times per week

b) For how many years have you taken a protein supplement?
- ○ 0 - 1 year
- ○ 2 - 4 years
- ○ 5 - 9 years
- ○ 10 or more years .

c) What brand of protein supplement do you take?

[ ]

- ○ Don't know

157. Where do you usually eat breakfast?
- ○ At home
- ○ At school
- ○ Fast food restaurant
- ○ Convenience store
- ○ Don't eat breakfast
- ○ Other

[ ]

158. Do you regularly eat breakfast from the school breakfast program?
- ○ Yes
- ○ No

159. Do you regularly eat lunch from the school lunch program?
- ○ Yes
- ○ No

PLEASE DO NOT WRITE IN THIS AREA

4341 H

160. How often do you eat after-school snacks?

- ○ Never or less than once per month
- ○ Less than once per week
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

161. How often do you eat dinner <u>prepared away from home</u>?

- ○ Never or less than once per month
- ○ Less than once per week
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

162. How often do you prepare dinner for yourself and/or others in your household?

- ○ Never or less than once per month
- ○ Less than once per week
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

163. How often do you eat late night snacks <u>prepared away from home</u>?

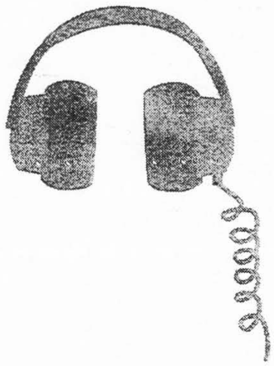
- ○ Never or less than once per month
- ○ Less than once per week
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week

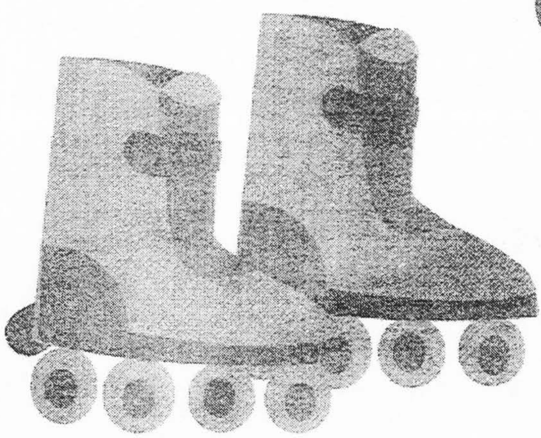
164. How often do you buy food from the school snack bar?

- ○ Never or less than once per month
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week
- ○ No snack bar at school

165. How often do you buy food or drinks from vending machines at your school?

- ○ Never or less than once per month
- ○ 1 - 2 times per week
- ○ 3 - 4 times per week
- ○ 5 or more times per week
- ○ No vending machines at school





Appendix C. Household Questionnaire for Utah Calcium Study

Household Questionnaire

Your responses to the following questions are completely confidential. If you prefer not to answer a question, leave it blank.

1. Today's date _______ _______ _______
   Month Day Year

2. What city do you live in? ____________________

3. What is your relationship to the child who is participating in this study?
   _____ Mother
   _____ Father
   _____ Grandmother
   _____ Grandfather
   _____ Legal guardian
   _____ Sibling
   _____ Other, please specify ____________________

4. Who is taking care of the child in <u>this</u> household?
   _____ Both mother and father
   _____ Mother only
   _____ Father only
   _____ One grandparent or relative
   _____ Two grandparents or relatives
   _____ One legal guardian
   _____ Two legal guardians
   _____ Other, please specify ____________________

5. Which of the following categories best describes the ethnic background of the child's biological mother?
   _____ Native American Indian (Please specify tribe ____________________)
   _____ Asian or Pacific Islander
   _____ Black or African American
   _____ Hispanic or Latino
   _____ White or Anglo or European American
   _____ Other, please specify ____________________
   _____ Don't know

Please Turn Over

6. Which of the following categories best describes the ethnic background of the child's biological father?
   _____ Native American Indian
   _____ Asian or Pacific Islander
   _____ Black or African American
   _____ Hispanic or Latino
   _____ White or Anglo or European American
   _____ Other, please specify __________________
   _____ Don't know

For questions 7-9, if the child lives in more than one household, use the household in which the child lives most of the time.

7. What is the highest level of education of the child's caretaker(s)? (Check one response for each caretaker.)
   _____ Never attended school or only attended kindergarten
   _____ Some high school education
   _____ High school diploma or equivalent
   _____ Completed vocational school
   _____ Some college
   _____ College or Baccalaureate degree (B.S., B.A.)
   _____ Masters degree, doctoral degree, or professional degree
   _____ Other degree, please specify __________________

8. What is the annual household income in which the child lives?
   _____ Less than $15,000
   _____ $15,000 to $29,999
   _____ $30,000 to $49,999
   _____ $50,000 to $74,999
   _____ $75,000 to $100,000
   _____ More than $100,000
   _____ Don't know

9. How many individuals live in the child's household? ______________

Thank you!

Appendix D. Permission Letter Copyright Release

June 8, 2004

J. Keith Jensen
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Journal of the American Dietetic Association
120 South Riverside Plaza, Suite 2000
Chicago, IL 60606-6995

To Permission Editor:

I am preparing my dissertation in the field of nutritional epidemiology at Utah State University. I hope to complete my degree in the fall of 2004.

An article, Development of a Food Frequency Questionnaire to Estimate Calcium Intake of Asian, Hispanic, and White Youth, of which I am first author, and which appeared in the Journal of the American Dietetic Association, reports an essential part of my dissertation research. I would like permission to reprint it as a chapter in my dissertation. Please note that USU sends dissertations to Bell & Howell Dissertation Services to be made available for reproduction.

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Development of a Food Frequency Questionnaire to Estimate Calcium Intake of Asian, Hispanic, and White Youth was published in the Journal of the American Dietetic Association, 2004;104:762-769.

Signed____

Date__________________

Fee __________________

ELSEVIER

Date: July 12, 2004 Our ref: FCR/JensenUtahStateLH7-04

Keith Jensen
keithjensen@cc.usu.edu

Dear Keith:

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CURRICULUM VITAE

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Awards and Honors:	May 2002	College of Family Life Teaching Assistant of the Year for teaching NFS 1020, an introductory course in human nutrition

Membership in Professional Societies: American Dietetic Association

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Courses Taught

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2002	The Science and Application of Human Nutrition	NFS 1020 (at USU)	840
2004	Essentials of Human Nutrition	NDFS 100 (at BYU)	1167

Community/Lay Public

Have taught and counseled as a dietitian for Women, Infants, and Children (WIC) from 1987 to 1997 and from August 2003 to present.

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Published

1. Novotny R, Boushey C, Bock MA, Peck L, Auld G, Bruhn C, Gustafson D, Gabel K, Jensen JK, Misner S, Read M. Calcium intake of Asian, Hispanic, and white youth. *J Am Coll Nutr.* 2003; 22:64-70.
2. Jensen JK, Gustafson D, Boushey C, Auld G, Bock MA, Bruhn C, Gabel K, Misner S, Novotny R, Peck L, Read M. Development of a food frequency questionnaire to estimate calcium intake in Asian, Hispanic, and white youth. *J Am Diet Ass.* 2004;104:762-769.

In Preparation

One paper in preparation titled, "Intake of calcium, milk, and non-milk beverages of Hispanic and non-Hispanic white youth in Utah."

Research Collaborations:

1. United States Department of Agriculture's W-191 regional project, 'Calcium Intake Among Youth' - University of California at Berkeley, University of Hawaii at Manoa, University of Nevada at Reno, Arizona State University, New Mexico State University, Colorado State University, University of Wyoming, Idaho State University, Purdue University, Washington State University, and Utah State University.
2. Creation of a dietary survey for northwest tribal elders in collaboration with Francine Romero, PhD, MPH, Portland Area Indian Health Board and Deb Gustafson, Utah State University.