Published in final edited form as:
J Food Compost Anal. 2008 February ; 21(Supplement 1): s60–s68.

Development of the Iowa bone nutrient food frequency questionnaire based on data from the US Department of Agriculture Continuing Survey of the Food Intake by Individuals[1]

Julie M.E. Gilmore*, **Teresa A. Marshall**, **Steven M. Levy**, and **Phyllis J. Stumbo**
College of Dentistry, University of Iowa, N342 DSB, Iowa City, IA 52242, USA

Abstract

An easily administered food frequency questionnaire (FFQ)/dietary screener was developed for current (adult) and retrospective (adolescent) intakes of nutrients important for bone development and maintenance. This tool quantified serving sizes and nutrients from foods using gender and age specific techniques. Nutrients of interest were calcium, vitamin D, caffeine and alcohol, and 15 categories of foods were selected for inclusion based on frequency of intake and nutrient density. Calcium-contributing foods were selected from published dietary intake assessment tools. Foods contributing vitamin D, caffeine and alcohol were selected based on nutrient density and Midwest consumption practices. Serving sizes were quantified in standard serving units or as small, medium and large servings. Food items selected for the FFQ/dietary screener were matched to foods from the United States Department of Agriculture (USDA) Continuing Survey of Food Intakes by Individuals (CSFII). Calcium, caffeine and alcohol values were assigned using CSFII data files at median values per 100g intake. CSFII midpoint tertile frequency of intake values for males and females 14–18 and 25–45 years old were used to establish serving weights for small, medium and large servings. CSFII data files provide an efficient way for estimating typical intakes, serving sizes and nutrient values for target groups. Age- and gender-derived data provided realistic estimates of nutrient intakes when using FFQ/dietary screener assessment method.

Keywords

Food frequency questionnaire; FFQ; Calcium assessment; Serving sizes; Continuing Survey of Food Intakes by Individuals; USDA; CSFII

1 Introduction

Calcium has long been recognized as an important nutrient essential for the formation and maintenance of bones and teeth. Many reports suggest calcium consumption during childhood and adolescence contributes to the achievement of peak bone mass that is considered to be essential for a healthy skeleton later in life (DeBar et al., 2006; Cheng et al., 2005; Fiorito et al., 2006; Matkovic et al., 2005). More recently evidence has emerged to suggest that calcium is of benefit at all stages of life for prevention of osteoporosis (Heaney and Weaver, 2005;

[1]Funding Disclosure: Supported by the National Institute for Dental and Craniofacial Research, National Institutes of Health (RO1-DE09551 and RO1-DE12101) and the University of Iowa General Clinical Research Center (MO1-RR00059).

*Corresponding Author. Tel: +1 319 353-5476; fax: +1 319 353-7187, E-mail address: julie-gilmore@uiowa.edu.

Gafni and Baron, 2007). In addition, attention has been given to the potential osteoblastic or osteoclastic impact of other nutrients and non-nutrient compounds including vitamin D, caffeine and alcohol (Ilich and Kerstetter, 2000). Numerous research protocols are currently ongoing to determine prevention and intervention strategies to help minimize the impact of deficits in bone mass potential and its consequences.

This paper describes the development of a food frequency questionnaire (FFQ) for estimating nutrient intake and describing portion sizes using data collected from a national survey. Specifically, the objective of this study was to develop a method for assigning nutrient values to FFQ entries and to describe serving sizes using gender and age specific techniques. The method allows the researcher to use the same FFQ for multiple age and gender groups. Block et al. (1986) described this technique in their early FFQ development where age/gender serving sizes were calculated from results of the Second National Health and Nutrition Examination Survey (NHANES II). The investigators calculated serving sizes for the five age/gender groups, 15–35, 35–44, 45–54, 55–64 and 65+ years. We extended this work to include nutrient values and serving sizes for adolescents (14–18 years) and adults (25–45 years).

2 Materials and methods

2.1 Study population

The longitudinal study of bone development conducted by the University of Iowa College of Dentistry is uniquely suited to evaluate many of the factors affecting bone mineralization in children and their parents. Detailed descriptions of this cohort have been published elsewhere (Levy et al., 1998). Briefly, newborn infants recruited between 1992 and1995 have continued to be followed for dietary, physical activity and genetic factors related to bone development. Dietary intake of the child cohort has been estimated using both 3-day food records and a brief semi-quantitative FFQ. To assess genetic contributions of bone health, enrollment for parents of these children began in 2000. Bone mineral content and density are measured with traditional dual photon x-ray absorptiometry as well peripheral quantitative computerized tomography. The Institutional Review Board at the University of Iowa approved all components of the research study.

2.2 Creation of the Iowa Bone Nutrient FFQ/Dietary Screener

To respond to the need for a dietary assessment tool to estimate calcium, vitamin D, caffeine and alcohol intakes of parents and relate those intakes to their children's intakes (previously collected), a brief (15 item) semi-quantitative FFQ/dietary screener was developed for current (adult) and retrospective (adolescent) intakes of the four components thought to impact bone development and maintenance. Special attention was paid to providing consistency with the previously collected children's intake data.

Two tools were developed to assess calcium, vitamin D, caffeine, and alcohol intake of parents. The first tool was designed to ascertain intake information for the year previous to bone studies and the second tool was to capture intake during the time period that the participants were either attending or eligible for high school. High school was selected as a period of time for capturing adolescent intake because it is typically an easily identifiable and quantifiable period of time for most individuals. Authors (PJS, TAM) created a list of 15 categories of foods that were thought to supply substantial amounts of calcium, vitamin D, alcohol or caffeine to the diet. Foods were selected for inclusion in the food list based on examination of food composition tables (USDA, 1976–1989), existing dietary questionnaires, and survey data on food intake patterns. Literature reviewed included Block's landmark paper identifying the top 50 foods contributing 94% of total calcium to the adult diet from data collected during the NHANES II survey, 1976–1980 (Block, et al., 1985). Several other published FFQs were

reviewed to insure appropriate selection of calcium containing foods (Blalock et al., 1987; Cummings et al., 1987; Musgrave et al., 1989; Smith et al., 1999). The selection of foods contributing vitamin D, caffeine and alcohol were based on the concentration of these constituents in foods along with consumption factors.

The food list became the basis for the Iowa Bone Nutrient FFQ/Dietary Screener (IBN FFQ/DS) (Figure 1). Food items identified for inclusion were milk (including flavored milk), yogurt, meal replacement foods, calcium-fortified fruit juice, coffee, tea, carbonated soft drinks, alcoholic beverages, frozen milk-based desserts, other milk-based desserts, cottage cheese, cheese and cheese sauce, cheese mixtures, green leafy vegetables, and legumes. Standard serving sizes were assigned to milk, yogurt, meal supplements, calcium fortified fruit juice, coffee, tea, soft drinks and alcoholic beverages using menu planning portion sizes developed by the United States Department of Agriculture (USDA) (USDA, 2007c). To maximize the accuracy of reporting other foods, three portion size response options were allowed for the categories of frozen milk-based desserts, milk-based desserts, cottage cheese, cheese and cheese sauce, cheese in mixtures, green leafy vegetables and beans. Small, medium and large serving sizes were assigned to these categories to capture variation in response by gender and age. Participants were asked to indicate their perception of their typical serving size. In other words, they were asked to describe their typical serving size as “small”, “medium” or “large” without portion size aids.

The tool was designed to be administered by registered dietitians. Participants were first asked if they had consumed that food during the past year (current intake). If the response was “yes,” they were asked how often, on average, the food portion was consumed during the past year. Participants are allowed to respond in number of servings per day, week or month, thus allowing the interviewer to capture relatively infrequent consumption patterns. For example, if 1 cup milk was consumed once per month for 3 months during the past year or 3 cups for the entire year, the interviewer coded it as 0.25 servings per month. A line of questioning followed to determine the typical serving size for the various ways a food was consumed. For example, if milk was consumed during the past year, the interviewer determined if it was consumed as a beverage, the typical portion size and the frequency of consumption. Additionally, if milk was consumed with breakfast cereal or as an addition to coffee or tea, those portion sizes and frequencies were determined and added to fluid milk consumption. The total average consumption for the category was computed, normalized for the typical serving size and recorded. If 2 cups of fluid milk was consumed per day, ½ milk used on cereal 3 times per week and 2 ounces milk used in coffee daily, the amount would be recorded as 17.25 cups per week or 2.46 cups per day. Frequency of consumption responses were handled in the same manner as the standard portion size categories. For all 15 categories, a frequency response that allowed for per day, week or month was available.

Upon completion of the questionnaire for current intake, the entire questionnaire was repeated to obtain information regarding retrospective intake during adolescence (high school) for all items with the exception of calcium fortified juice beverages which were not available on the market during the time that the participants were 14–18 years of age. Questions regarding dietary supplement use and open-ended questions regarding brand names of vitamin, mineral, herbal and other botanical supplements were included on the screener and in the interview, but are not the focus of this report.

2.3 Nutrient and serving size assignment

The Continuing Survey of Food Intakes by Individuals (CSFII) Diet and Health Knowledge Survey database was used for nutrient and serving size assignment (USDA, 2007a). The CSFII is a nationally represented survey with participants residing in all 50 US states and includes an over sampling of the low-income population. Dietary information was collected by in-person

interviews for two non-consecutive 24-hour dietary recalls. Of all CSFII eligible participants, 80% participated in the first dietary interview and of those, 95% participated in the second dietary interview. To maximize the number of food item entries represented by their intake and to avoid overestimation of frequency of consumption by any one individual, we used the first interview as our data source. We identified all CSFII food codes appropriate for each of our IBN FFQ/DS categories. For example, 112 food codes for milk and 20 food codes for yogurt were identified (Table 1). Next these food codes were linked to subject intake files for CSFII participants 14–18 and 25–45 years of age. These ages were chosen to match the high school and the majority of current ages of participating parents. Once food intake records were identified, each food category was evaluated for nutrient contributions. The variables extracted from CSFII food name file (n = 7321) included 916 foods eligible for consideration for the categories represented by the IBN FFQ/DS. The food codes for each IBN FFQ/DS category were linked to CSFII subject intake files to obtain food item serving size (g), and calcium (mg), caffeine (mg) and alcohol (g) associated for individual intake records. These line item nutrient values were normalized by calculating 100g nutrient intake values. The median nutrient value per 100g food within each food category was used for nutrient values for the IBN FFQ/DS categories.

Standard serving sizes were assigned for beverages, yogurt and meal replacements using USDA menu planning portion size guidelines (USDAc). The tertile midpoint values for CSFII food intake consumption quantities were used to establish serving weights for small, medium and large servings for the remaining categories (frozen milk-based desserts, milk-based desserts, cottage cheese, cheese and cheese sauce, cheese mixtures, green leafy vegetables and dry beans).

Vitamin D values from the USDA provisional table on the vitamin D content of foods and the National Nutrient Database for Standard Reference were used to impute values to the IBN FFQ/DS (USDA, 1999; 2007b).

3 Results

Of the 916 eligible food codes, 510 were consumed by CSFII participants ages 14–18 and 25–45 years. The number of CSFII food items represented in the IBN FFQ/DS ranged from 2 to 151 per category; however, the number consumed by the age groups of interest ranged from 2 entries for beer (regular and reduced calorie) to 101 entries for cheese and cheese sauce. The individual food records provided 16,812 food entries for evaluation, with milk reported 3,306 times by 2,226 individuals. The categories representing the lowest levels of CSFII intake were meal replacements (78 food item matched entries), calcium fortified fruit juice (7), mixed drinks (44), and cottage cheese (59). Those reported with the greatest levels of frequency were milk (3,306 food item matched entries), caffeine-containing coffee (2196), caffeine-containing carbonated soft drinks (3423), and cheese and cheese sauce (2112) (Table 1).

The CSFII intake files were queried iteratively to determine intake by category for the whole group (combined males and females, ages 14–18 and 25–45 years), males (ages 14–18 and 25–45 years combined), females (ages 14–18 and 25–45 years combined), adolescent males (ages 14–18 years), adolescent females (ages 14–18 years), adult males (ages 25–45 years) and adult females (ages 25–45 years). Median nutrient values for calcium, alcohol and caffeine and estimates for vitamin D per 100 g food are shown in Table 2.

Serving sizes for IBN FFQ/DS categories with small, medium and large portion sizes are provided in Table 3. The portion sizes for males exceeded those of females in all categories with the exception of a small serving of frozen milk-based desserts in which the sizes were identical. Among 14–18 year-olds, a small serving of frozen milk-based desserts and a medium

serving of dry beans were the same for both genders. Portion sizes for all other categories were greater for 14–18 year-old males except the small and large portions of cottage cheese, and the small portion of dry beans. Portion sizes for 25–45 year-old males exceeded those for females of the same age group except for small portions of frozen milk-based desserts and dry beans. In general, adolescent male portion sizes of frozen milk-based desserts, cheese and cheese sauce were greater than adult males; whereas their portion sizes of milk-based desserts were similar and portion sizes of cheese mixtures were somewhat less. Among adolescent females, portion sizes for frozen milk-based desserts were greater than adult females while portion sizes for milk-based desserts, cheese and cheese sauce, and cheese mixtures were approximately the same. Small cell sizes for cottage cheese, green leafy vegetables and dry beans preclude inference regarding relative portion sizes.

Table 4 provides detail regarding the arithmetic factors need to equate small and large serving sizes to a medium serving size. Across all age and gender groups, factors for relating a small serving to a medium serving ranged from 0.2 to 0.8 with two thirds of the factors in the range of 0.4 to 0.6 indicating a small portion is approximately 50% of the size of a medium portion. Factors for relating a large serving to a medium serving ranged from 1.1 to 4.0 and approximately one half of the factors were in the range of 1.9 to 2.1.

4 Discussion

The primary objective of the IBN FFQ/DS was to capture the nutrient intakes for parents of children participating in a longitudinal bone study, with current intake and intake during high school as the exposure time points of interest. High school was chosen because it is a period during which the bones are still growing and provides an estimate of dietary habits and nutrient intake during adolescence. Furthermore it is an easily defined and fairly memorable time period for most individuals. The methodology described above can be used to apply nutrient values and portion sizes to age and gender specific FFQs.

The methodology used to construct the tool allowed us the ability to capture sources of nutrients and food constituents that are significant dietary source but are sometimes overlooked. For example, milk added to coffee is queried with our tool and may contribute substantially to intake.

Utilizing CSFII data to obtain calcium, alcohol and caffeine values per 100g of food provided values comparable to other data sources. However, the variability in portion size by age-gender groups was not as great as anticipated. The relationship between sizes is similar to what others have reported (Subar et al., 2000). That is, a small serving is approximately one half of a medium serving and a large serving is approximately twice a medium serving. The category “cheese and cheese sauce” tended to exhibit a different pattern of proportionality. The small serving was one half a medium serving but the large serving was approximately 3 to 4 times the medium serving. The impact of this difference should not be overlooked. If a factor of 2 times a medium serving was used to define a large serving, the underestimation of calcium could be as much as 357 mg calcium per serving per day.

To estimate quantities of nutrients, CSFII was chosen as the data source. CSFII provides nutrient intakes of over 20,000 individuals of all ages using a nationally representative sample. The survey used adequate numbers of participants for each age-gender group to ensure diversity of intakes and importantly, statistical reliability of the nutrient estimates (Tippett and Cypel, 1997).

Although the methodology presented is fairly easy to execute for other food frequency tools, there are some limitations that must be considered. First, the food supply and access to food has evolved over the past several years as evidenced by the link between “super sizing” and

the obesity epidemic. In addition, portion sizes have increased in many restaurants and for retail foods causing the consumer to experience a change in the perception of an average portion size. A recent study found that subjects chose significantly higher quantities of food than subjects in a similar study conducted 20 years ago (Schwartz and Byrd-Bredbenner, 2006). Portion distortion may limit the ability to apply CSFII, 1994–96 data to more contemporary dietary tools. Furthermore, CSFII reports food intakes in quantities that appear to be multiple servings, e.g., one bottle of wine (750 ml) rather than five glasses of wine (150 ml each) suggesting the interviewer may have grouped some items for the 24 hour intake. This grouping of food and beverage items creates misrepresentation of a portion size when using the methodology described herein. Because we were unable to distinguish single servings at one time exposure from multiple servings grouped from multiple exposures, all data were used to determine tertile midpoints. In most cases cell sizes were sufficient to avoid notable problems but grouping of CSFII food entries has the potential to increase or decrease the estimated weights for serving sizes when using the median of each tertile to establish sizes.

Second, foods such as calcium fortified fruit juice and other calcium fortified products have gained popularity in recent years due to targeted manufacture and marketing of foods that help prevent osteoporosis. Hence, they were most likely not consumed, and therefore, not reported in the CSFII survey and the accompanying nutrient dataset. If the primary intent of an assessment tool is to capture calcium intake, a thorough review of calcium fortified products would be necessary.

Finally, the demographics of the diverse participant pool utilized by CSFII may be different from the Iowa group.

5 Conclusions

Food diaries and 24-hour recalls are optimal methods of collecting dietary data; however, when cost, participant burden and data comparability are issues, brief questionnaires such as the one presented in this article may be useful to capture the intake of targeted nutrients such as calcium, vitamin D, caffeine and alcohol. CSFII data files provide an efficient way for estimating typical intakes, serving sizes and nutrient values for target groups. The CSFII age and gender derived data provide realistic estimates of nutrient intakes when utilizing FFQ assessment methods.

References

Blalock SJ, Currey SS, DeVellis RF, Anderson JJB, Gold DT, Dooley MA. Using a short food frequency questionnaire to estimate dietary calcium consumption: a tool for patient education. Arthritis Care Research 1987;11:479–484.

Block G, Dresser CM, Hartman AM, Carroll MD. Nutrient sources in the American diet: quantitative data from the NHANES II survey. I. Vitamins and minerals. American Journal of Epidemiology 1985;122:13–26. [PubMed: 4014190]

Block G, Hartman AM, Dresser CM, Carroll MD, Gannon J, Gardner L. A data-based approach to diet questionnaire design and testing. American Journal of Epidemiology 1986;124:453–469. [PubMed: 3740045]

Cheng S, Lyytikaninen AL, Kroger H, Lamberg-Allardt C, Alen M, Koistinen A, Wang QJ, Suuriniemi M, Suominen H, Mahonen A, Nicholson PHF, Ivaska KK, Korpela R, Ohlsson C, Vaananen KH, Tylavsky F. Effects of calcium, dairy product, and vitamin D supplementation on bone mass accrual and body composition in 10-12-y-old girls: a 2-y randomized trial. American Journal of Clinical Nutrition 2005;82:1115–1126. [PubMed: 16280447]

Cummings SR, Block G, McHenry K, Baron RB. Evaluation of two food frequency methods of measuring dietary calcium intake. American Journal of Epidemiology 1987;126:976–802.

DeBar LL, Ritenbaugh C, Aickin M, Orwoll E, Elliot D, Dickerson J, Vuckovic N, Stevens VJ, Moe E, Irving LM. A health plan–based lifestyle intervention increases bone mineral density in adolescent girls. Archives of Pediatric Adolescent Medicine 2006;160:1269–1276.

Fiorito LM, Mitchell DC, Smiciklas-Wright H, Birch LL. Girls' calcium intake is associated with bone mineral content during middle childhood. Journal of Nutrition 2006;136:1281–1286. [PubMed: 16614417]

Gafni RI, Baron J. Childhood bone mass acquistion and peak bone mass may not be important determinants of bone mass in late adulthood. Pediatrics 2007;119:131S–136S.

Heaney RP, Weaver CM. Newer perspective on calcium nutrition and bone quality. Journal of the American College of Nutrition 2005;24:574S–581S. [PubMed: 16373957]

Ilich JZ, Kerstetter JE. Nutrition in bone health revisited: a story beyond calcium. Journal of the American College of Nutrition 2000;19:715–737. [PubMed: 11194525]

Levy SM, Kiristsy MC, Slager SL, Warren JJ. Patterns of dietary fluoride supplement use during infancy. Journal of Public Health Dentistry 1998;58:228–233. [PubMed: 10101699]

Matkovic V, Goel PK, Badenhop-Stevens NE, Landoll JD, Li B, Ilich JZ, Skugor M, Nagode LA, Mobley SL, Ha EJ, Hangartner TN, Clairmont A. Calcium supplementation and bone mineral density in females from childhood to young adulthood: a randomized controlled trial. American Journal of Clinical Nutrition 2005;81:175–188. [PubMed: 15640478]

Musgrave KO, Giambalvo L, Leclerc HL, Cook RA, Rosen CJ. Validation of a quantitative food frequency questionnaire for rapid assessment of dietary calcium intake. Journal of the American Dietetic Association 1989;89:1484–1488. [PubMed: 2794308]

Schwartz J, Byrd-Bredbenner C. Portion distortion: typical portion sizes selected by young adults. Journal of the American Dietetic Association 2006;106:1412–1418. [PubMed: 16963346]

Smith BA, Morgan SL, Vaughn WH, Fox L, Canfield GJ, Bartolucci AA. Comparison of a computer-based food frequency questionnaire for calcium intake with 2 other assessment tools. Journal of the American Dietetic Association 1999;99:1579–1581. [PubMed: 10608957]

Subar AF, Midthune D, Kulldorff M, Brown CC, Thompson FE, Kipnis V, Schatzkin A. Evaluation of alternative approaches to assign nutrient values to food groups in food frequency questionnaires. American Journal of Epidemiology 2000;152:279–286. [PubMed: 10933275]

Tippett, KS.; Cypel, YS., editors. Design and operation: the continuing survey of food intakes by individuals and the diet and health knowledge survey, 1994–96. Continuing survey of food intakes by individuals 1994–96, nationwide food surveys. Report 96-1. United States Department of Agriculture, Agricultural Research Service; Beltsville, MD: 1997.

United States Department of Agriculture (USDA). Composition of Foods: Raw, Processed, Prepared Agriculture Handbook No. 8, revised, 8-1 through 8-21 and Supplements. Government Printing Office; Washington, DC: 1976–1989.

United States Department of Agriculture (USDA), Agricultural Research Service, Food Surveys Research Group. Continuing Survey of Food Intakes by Individuals (CSFII) 1994–96, 1998 and Diet and Health Knowledge Survey 1994–96. 2007a. Retrieved 2007-07-17 from: Http://www.ars.usda.gov/Services/docs.htm?docid=14531, Documentation: csfii9498_documentationupdated.pdf or Data Files: csfii9498_data.exe

United States Department of Agriculture (USDA), Agricultural Research Service, Nutrient Data Laboratory. USDA National Nutrient Database for Standard Reference, Release 19. 2007b. Retrieved 2007-03-17 from: http://www.nal.usda.gov/fnic/foodcomp/search/

United States Department of Agriculture (USDA), Food and Nutrition Service, Child and Adult Care Food Program. Menu Planning. 2007c. Retrieved 2007-07-17 from: http://www.fns.usda.gov/cnd/care/ProgramBasics/Meals/Meal_Patterns.htm

United States Department of Agriculture (USDA), Human Nutrition Information Service. Provisional Table on the Vitamin D Content of Foods, HNIS/PT-108. 1999. Retrieved 2007-03-17 from: http://www.nal.usda.gov/fnic/foodcomp/search/

. . . . . *Current Food Habits* . . . . .

Modified Food Frequency Questionnaire to Assess Calcium, Vitamin D, Caffeine, and Alcohol Intake

Subject ID: |___|___|___|___|___|___|

Today's Date: |___|___| (Month) |___|___| (Day) **20** |___|___| (Year)

Please think about the past year as you answer the following questions.

1. Please answer our questions about how much of these foods you ate during the past year.

	Food Name	Serving Size:	Number of servings per: Day	Week	Month
a.	**Milk:** Whole, 2%, 1%, skim or nonfat, low lactose, buttermilk (include Kefir milk), chocolate, cocoa, milkshake, include milk in coffee, tea and cereal.	1 cup (8 oz.)			
b.	**Yogurt:** Plain, flavored, fruit variety.	1 cup			
c.	**Meal replacement beverages/bars RTE:** Instant breakfast®, Ensure®, Sustacal®, Slimfast®, Nestle Sweet Success®, Nutrition Bars and Slim Fast Bar.	1 cup or bar			
d.	**Fruit juice fortified with calcium**	½ cup juice			
e.	**Coffee,** regular	1 cup			
	Coffee, decaffeinated				
f.	**Tea,** regular	1 cup			
	Tea, decaffeinated				
g.	**Soft drinks** (list brand if known)	1 can (12 oz)			
	_____				
	_____				
	_____				
	_____ (optional)				
h.	**Alcoholic beverages:** Beer, wine cooler, wine, cocktails or mixed drinks: with whiskey, vodka or gin such as whiskey sour, margarita, martini, screwdriver, bloody Mary.	**Beer** (12 oz)			
		Wine (4 oz)			
		Mixed drink (6-8 oz)			
i.	**Frozen milk-based desserts:** Regular or soft serve ice creams, ice milk, or frozen yogurt, ice cream bar or sandwich.	S M L			
j.	**Milk-based desserts:** Pudding, bread pudding, custard, flan, rice and tapioca pudding, cream pie.	S M L			
k.	**Cottage cheese**	S M L			

Food Name	Serving Size:	Number of servings per: Day	Week	Month
l. **Cheese, cheese sauce:** Cheese sandwich, cheeseburger, cheese in deli sandwich, cheese and crackers, nachos, grated cheese on baked potato or salad, vegetables with cheese sauce.	S M L			
m. **Cheese in mixtures:** Macaroni and cheese, lasagna, pizza, cheese soup, omelet or scrambled eggs with cheese.	S M L			
n. **Green leafy vegetables:** Cooked dark green vegetables like spinach, collards, mustard greens, kale, turnip greens, okra, broccoli, cabbage, and raw cabbage slaw.	S M L			
o. **Beans:** From dry: pork and beans, baked beans, refried beans, bean soup, chili, garbanzos (don't count if only sprinkled on salad).	S M L			

2. How often did you take the following supplements during the past year? (Check appropriate box)

Multiple Vitamins:	None	1-3/wk	4-6/wk	1/day	2/day	3/day	4+/day	Brand if known
Stress-tabs type								
Therapeutic, Theragran type								
One-A-Day type								
Prenatal Vitamins								
Calcium or Tums								
Vitamin D (alone or w/calcium)								
Other:								

3. Did you consume any other kind of supplement (include herbs and botanicals such as ginseng, acerola, other fresh, dried or bottled products from a drugstore, health store, or grocery) during the past year?

____No ____Yes, fairly regularly ____Yes, but not regularly

3a. If yes, what did you take fairly regularly? (please list):

_____

_____

_____

_____

_____

_____

Fig. 1.

Iowa Bone Nutrient Food Frequency Questionnaire/Dietary Screener (IBN FFQ/DS)

Table 1

Iowa Bone Nutrient Food Frequency/Dietary Screener (IBN FFQ/DS) food categories and the number of CSFIIa food entries representative of those categories

Food Item Category from IBN FFQ/DS	CSFII Food Items Names representative of IBN FFQ/DS (n)	Food items reported by14–18 and 25–45 year-old CSFII respondents (n)	CSFII food item matched entries (n)	CSFII persons 14–18 and 25–45 years reporting intake (n)
Milk	112	52	3306	2226
Yogurt	20	15	168	156
Meal replacements	44	16	78	64
Calcium-fortified fruit juice	6	2	7	7
Coffee				
Caffeine-containing	38	17	2196	1663
Caffeine-free	10	5	172	148
Tea				
Caffeine-containing	10	7	517	388
Caffeine-free	9	7	122	80
Carbonated soft drinks				
Caffeine-containing	17	10	3423	2221
Caffeine-free	15	15	1085	822
Alcoholic beverages				
Beer	2	2	610	480
Wine	9	6	158	143
Mixed drinks	40	14	44	41
Frozen milk-based desserts	114	65	644	609
Milk-based desserts	75	36	139	120
Cottage cheese	16	8	59	59
Cheese, cheese sauce	151	101	2112	1705
Cheese mixtures	54	36	949	854
Green leafy vegetables	62	35	411	385
Dry beans	112	61	612	536
TOTAL	916	510	16812	12707

aCSFII = U.S. Department of Agriculture Continuing Survey of the Food Intake of Individuals.

Table 2

Iowa Bone Nutrient Food Frequency Questionnaire/Dietary Screener (IBN FFQ/DS) nutrient assignments by food category

Food Item Category from IBN FFQ/DS	Calcium (mg/100 g) [a]	Alcohol (g/100 g) [a]	Caffeine (mg/100 g) [a]	Vitamin D [b] (IU/100 g)
Milk	122	0	0	40
Yogurt	152	0	0	0
Meal replacements	294	0	0	40
Calcium-fortified fruit juice	121	0	0	40
Coffee				
Caffeine-containing	2	0	58	0
Caffeine-free	2	0	1	0
Tea				
Caffeine-containing	0	0	19	0
Caffeine-free	0	0	1	0
Carbonated soft drinks				
Caffeine-containing	3	0	10	0
Caffeine-free	3	0	0	0
Alcoholic beverages				
Beer	5	4	0	0
Wine	8	9	0	0
Mixed drinks	3	13	3	0
Frozen milk-based desserts	128	0	0	0
Milk-based desserts	79	0	0	35
Cottage cheese	60	0	0	0
Cheese, cheese sauce	627	0	0	12
Cheese mixtures	163	0	0	3
Green leafy vegetables	46	0	0	0
Dry beans	38	0	0	0

[a] Value assigned using median value of individual food item intake records from the U.S. Department of Agriculture Continuing Survey of the Food Intake of Individuals.

[b] Vitamin D values were assigned using the U.S. Department of Agriculture provisional table on the vitamin D content of foods and the National Nutrient Database for Standard Reference, Release 19.

Table 3

Portion size weights for Iowa Bone Nutrient Food Frequency/Dietary Screener (IBD FFQ/DS) food categories by age-gender categories

	Total	Male	Female	Male 14–18 years	Female 14–18 years	Male 25–45 years	Female 25–45 years
Frozen milk-based desserts, *n*	*644*	*342*	*302*	*73*	*67*	*269*	*235*
Small, g	66	66	66	66	66	66	66
Medium, g	133	145	133	170	147	138	132
Large, g	266	282	262	359	294	266	220
Milk-based desserts, *n*	*142*	*69*	*73*	*17*	*16*	*52*	*57*
Small, g	95	113	81	108	95	113	76
Medium, g	144	149	131	144	130	154	133
Large, g	261	266	206	261	162	272	206
Cottage cheese, *n*	*59*	*25*	*34*	*3*	*3*	*22*	*31*
Small, g	52	63	27	28	52	63	27
Medium, g	113	210	105	140	113	210	105
Large, g	226	226	218	226	420	226	165
Cheese, cheese sauce, *n*	*2112*	*1171*	*941*	*256*	*209*	*915*	*732*
Small, g	14	21	12	21	14	20	12
Medium, g	28	38	28	42	24	34	28
Large, g	113	126	85	164	83	126	85
Cheese mixtures, *n*	*949*	*525*	*424*	*153*	*100*	*372*	*324*
Small, g	75	83	66	79	64	92	69
Medium, g	162	191	143	162	127	208	144
Large, g	344	382	284	358	285	393	285
Green leafy vegetables, *n*	*411*	*192*	*219*	*18*	*31*	*174*	*188*
Small, g	22	26	22	34	16	25	22
Medium, g	92	92	80	92	38	92	89
Large, g	184	184	172	199	120	184	184
Dry Beans, *n*	*612*	*349*	*263*	*52*	*44*	*297*	*219*
Small, g	57	63	45	33	49	63	45
Medium, g	127	172	123	126	126	173	119
Large, g	262	344	244	254	190	346	248

Table 4

Small and large portion size factors relative to medium serving sizes based on tertile midpoints of reported intake from the U.S. Department of Agriculture Continuing Survey of the Food Intake of Individuals

	Total	Male	Female	Male 14–18 years	Female 14–18 years	Male 25–45 years	Female 25–5 years
Frozen milk-based desserts							
Small	0.5	0.5	0.5	0.4	0.4	0.5	0.5
Large	2.0	1.9	2.0	2.1	2.0	1.9	1.7
Milk-based desserts							
Small	0.7	0.8	0.6	0.8	0.7	0.7	0.6
Large	1.8	1.8	1.6	1.8	1.2	1.8	1.5
Cottage cheese							
Small	0.5	0.3	0.3	0.2	0.5	0.3	0.3
Large	2.0	1.1	2.1	1.6	3.7	1.1	1.6
Cheese, cheese sauce							
Small	0.5	0.6	0.4	0.5	0.6	0.6	0.4
Large	4.0	3.3	3.0	3.9	3.5	3.7	3.0
Cheese mixtures							
Small	0.5	0.4	0.5	0.5	0.5	0.4	0.5
Large	2.1	2.0	2.0	2.2	2.2	1.9	2.0
Green leafy vegetables							
Small	0.2	0.3	0.3	0.4	0.4	0.3	0.2
Large	2.0	2.0	2.2	2.2	3.2	2.0	2.1
Dry Beans							
Small	0.4	0.4	0.4	0.3	0.4	0.4	0.4
Large	2.1	2.0	2.0	2.0	1.5	2.0	2.1