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Development and Evaluation of an Electronic Food Frequency Questionnaire for Estimating Calcium Intake among Multiethnic Youth

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DEVELOPMENT AND EVALUATION OF AN ELECTRONIC FOOD FREQUENCY QUESTIONNAIRE FOR ESTIMATING CALCIUM INTAKE AMONG MULTIETHNIC YOUTH

by

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ABSTRACT

Development and Evaluation of an Electronic Food Frequency Questionnaire for Estimating Calcium Intake among Multiethnic Youth

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Youth consuming inadequate amounts of calcium are at risk of developing osteoporosis later in life. To better assess dietary calcium intakes and the efficacy of dietary intervention strategies to improve bone health among youth, it is important to develop calcium intake assessment tools that are reliable, accurate, and interactively engaging for a new generation of youth who have a higher computer literacy and are more technologically knowledgeable than preceding generations. The goal of this dissertation was to develop and evaluate an electronic food frequency questionnaire (eFFQ) that measures calcium intake among 11- to 18-year-old Asian, Hispanic, and White youth. Enhancing this tool was the inclusion of 100 original digital color food photographs portraying the foods listed in the eFFQ. A formal evaluation study, as well as formative and summative evaluations of food photos and the eFFQ, was accomplished.

(117 pages)

To my beloved husband Chet Lo,

whose love and support never failed from the beginning to the end of my doctoral degree.

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Siew Sun Wong

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CHAPTER 1

INTRODUCTION

Dietary calcium intake is strongly and inversely associated with fracture risk due to osteoporosis, which affects women, men, and all ethnicities to varying degrees (1). Youth in the United States are particularly at risk not only because current calcium intakes are significantly below the recommended 1300 mg/day (2, 3), but because their calcium intake is also declining (4, 5), especially during this critical peak-bone-mass building period in their lives.

With this, increasing attention has been given to calcium intake assessment among youth. One of the most widely used methods of assessing dietary intake is the food frequency questionnaire (FFQ), and thus far, there have been several FFQs designed for youth that specifically estimate calcium intake only (4, 6-12) or intake of calcium and other nutrients (13-19). Table 1-1 reviews studies focusing on youth's diet with or without measuring calcium intake.

In this era of computer-assisted education, and youth being increasingly savvy with computers and highly interactive multimedia software programs at younger and younger ages, the development of computerized dietary assessment tools for use in research settings has begun. An electronic dietary assessment tool for youth may allow better estimates of calcium intake and subsequent osteoporosis risk, and may be effective for the assessment of dietary intervention strategies to improve bone health among youth. Electronic surveys may also contain information that will help individuals more accurately estimate their intakes, such as pictures, measuring aids, and sound; and

provide encouragement for survey completion.

A few computerized, self-administered FFQs have been reported to be reproducible and comparable to 'gold standard' dietary assessment tools such as 24 hour dietary recalls (24hdr), food diaries, and weighed food records (20-23). However, related to measurement of calcium intake, there has been no formal evaluation of a self-administered, electronic FFQ (eFFQ) specifically designed to measure calcium intake among youth, although there are some web-based FFQs that are designed to measure calcium intake (some even designed for youth) (24-32). Table 1-2 reviews web-based calcium assessment tools. Rows shaded in gray represent evaluation studies that focused on other nutrients not including calcium.

The purpose of this project was to create and evaluate an electronic version of the previously evaluated W191 FFQ (6), designed to measure calcium intake among 11- to 18-year-old Asian, Hispanic, and White youth living in the United States. Three studies were conducted within the context of this project. In the first study, a set of color food photos portraying each food item on the W191 FFQ food list was created, formatively evaluated by focus groups, and subsequently improved before it was incorporated into the electronic FFQ (eFFQ). In the second study, the eFFQ was evaluated against 24hdr over four consecutive weeks among multiethnic youth (see Appendix D for 24hdr recording form and face sheet). In the third study, summative evaluation of the eFFQ was used to assess participants' overall liking of the instrument, to evaluate the final set of food photos, and to identify areas for improvement (see Appendix E for questionnaire).

Table 1-1. Review of studies focusing on youth's diet with or without measuring calcium intake

Reference	N	Age, race of subject	FFQ	24hdr	Item Analyzed	Results / Correlations
Barr (4)	785	High School; A, W, Other	Ca FFQ (validated n=130 using 1 24hdr)	3 d FR	Ca	FFQ1*FFQ2 = 0.58; FFQ2*24hdr (Ca) = 0.61
Jensen (6)	162	10-18 y; A, H, W	W191 SQFFQ, paper format, 80 items	2 24hdrs	Ca	FFQ1*FFQ2 = 0.68; FFQ2*24hdr = 0.54
Loos (7) HERITAGE Family Study	824	362 M + 462 F (17-65 y)	Willett FFQ	-	Ca + Obesity	-
Phillips (8)	196	8-12 y (follow 4 yrs)	Willett FFQ	-	Ca/dairy food + Obesity	Dairy intake is not a/w BMI
Rozen (9)	2000	Israeli (Jews, Arab) F, mean age = 14.5 y	SQFFQ	-	Ca	Mean Ca intake = 1260 mg/d
Welten (10)	166	29 y Dutch, M & F	Quantitative DQ (retrospective 8 & 16 y previously)	-	Absolute Ca intake	Retrospectively reported Ca intake was overestimated; DQ is a relatively poor tool to assess the absolute Ca intake of young adults 8 & 16 yr ago.
Welten (11) Amsterdam Growth & Health Study	182	84 M + 98 F Dutch, 13-27y followed 15 yr		Cross-check 6x DH	Ca & dairy intake	Ca M: 0.43 F: 0.38
Zhang (12)	293	14±0.1y Chinese females	1 yr FFQ	3d (2wd + 1we FR)	Ca	FFQ*FR 0.368
Gilman (13)	16202	9-14 y	SQFFQ	-	General including Ca	↑ Family dinner ↑ Ca intake
MacIntyre (14)	144	15-65 y, African	Interviewer-administered QFFQ, paper 145; 2x (6-12 wk apart)	None	General including Ca	FFQ1*FFQ2 for Ca = 0.14
Rockett (15)	16882	9-14 y	Paper 131 YAQ (validated)		General including Ca	Ca intake <100% RDA
Rockett (16)	179	9-18 y, multiethnic	YAQ paper 151 (validated); 2x (1 yr apart)		General including Ca	FFQ1*FFQ2: *r* = 0.58 for Ca
Teegarden (17)	224	W, F (18-31y)	Retrospective Milk Hx Questionnaire	(Bone measurement: BMC & BMD of total body, spine, radius)	Daily Ca & Milk intake	↑ milk intake during adolescence a/w ↑ spine, total body, radius, BMC, and BMD

Table 1-1. (Continued)

Engle (20)	50	Adult	QFFQ	7d FR	General + Ca	FFQ1*FFQ2 = 0.58; FFQ2*FR = 0.62
Fidanza (21)	46	Adult Italian	FFQ	7d weighed FR	General + Ca	FFQ*FR = from 0.33 for ascorbic acid to 0.84 for alcohol
Heath (22)	49	19-31 y F	Iron FFQ	weighed FR	General + Ca	Range of FFQ*FR = 0.39-0.87
Vereecken (18)	767	207 (11-12yr) + 560 (13-14yr)	FFQ 15 (validated)		General including Ca	Spearman FFQ1*FFQ2 = 0.52-0.82; 37-87% agreement; Kappa = 0.43-0.70
Xie (19)	3201	11-20	Paper 131 Y/AFFQ (validated)		General including Ca	Ca < 100% RDA, significant gender difference in Ca intake
Brown (33)	96	5th & 6th grade, Am Indians (Hopi)		3d DR	Kcal, macronutrients, 10 vit & 6 min, including Ca	Mean Ca intake = 874 mg
Welten (34)	160	27-29 y Dutch	Quantitative DQ (retrospective 8 & 16 yr previously), 1 yr apart	Diet Hx	Ca intake	FFQ1*FFQ2 = 0.78 FFQ*DR = 0.58-0.65
Yaroch (35)	22 (sub-sample of (36)	11-17 African Am F, low income	Modified Pic-sort FFQ	3x	Macronutrients, SFA & Chol	FFQ*Avg24hdr 0.32-0.87
Yaroch (36)	57	11-17 African Am F, low income, overweight	Modified qualitative dietary fat index questionnaire (QFQ), 2wk apart	3x	Fat	
Smith (37)	365	7th Grade; Multiethnic	CATCH Food checklist	1	Total fat, SFA, Na	0.36 for total fat, 0.36 for SFA, and 0.34 for Na
Van Assema (38)	691	Dutch (52 Adults + 639 Adol)	Tel-FFQ; 25	7-d DR	Fat	0.59 (FFQ*7DR)
Van Assema (39)	95	45 Adults + 50 Adol (12-18 y)	FFQ	7-d DR	Total Fat & SFA	Adol: 0.6 Adult: 0.7 (FFQ*7DR)
Van Assema (40)	100	49 Adults + 51 Adol (12-18 y)	FFQ	7-d DR	FV	Adult: ≥0.5 Fruit Adol: 0.53-0.64 Total FV, Total fruit + juice

Table 1-1. (Continued)

List of Abbreviation

↑ = Increased
* = Correlated with
24hdr = 24-hour dietary recall
A = Asians
Adol = Adolescents
Avg24hdr = Average intake from 24-hour dietary recalls
Am = American
a/w = associated with
BMC = Bone mineral calcium
BMD = Bone mineral density
BMI = Body mass index
Ca = Calcium
Chol = Cholesterol
d = day
DH = Diet History
DR = Dietary records
DQ = Dairy Questionnaire
Hx = History
F = Females
FFQ = Food frequency questionnaire
FFQ1 = First food frequency questionnaire
FFQ2 = Second food frequency questionnaire
FR = Food record
FV = Fruits and vegetables
H = Hispanics M = Males
Min = mineral
Na = Sodium
QFFQ = Quantitative
SFA = Saturated Fatty Acids
SQFFQ = Semi-quantitative food frequency questionnaire
Tel = Telephone-survey
Vit = vitamin
W = Whites
wd = Weekday
we = Weekend
Wk = Week
x = times
y = Years old
YAQ or Y/AFFQ = Youth/Adolescent Questionnaire
yr = years

W-191 WESTERN MULTISTATE RESEARCH PROJECT

The W-191 Project named "Factors Influencing the Intake of Calcium Rich Foods among Adolescents" was supported by the State Agricultural Experiment Station. Collaborating states included Arizona, California, Colorado, Hawaii, Idaho, Indiana, New Mexico, Nevada, Utah, Washington, and Wyoming. The four major objectives of this project are:

1. To identify the most salient motivators and barriers influencing the consumption of calcium rich foods among adolescents,
2. To assess knowledge and attitudes towards calcium rich foods among adolescents,
3. To assess calcium intake among adolescents, and
4. To determine variation in motivators and barriers, attitudes and knowledge and consumption of calcium rich foods across age, gender and selected ethnic groups.

Table 1-2. Review of web-based calcium assessment tools

Reference / Program	Items in FFQ	Enter Age?	Option to go forward and backward, change, or check answer	Semi-quantitative: portion size provided	Provide summary of answers & analysis	Include colorful food pictures	Include Sound	Print option for results	Tips or recipes
Washington DC[a], Calcium Calculator (32)	27	✓	✓	✓	✓	✓	x	✓	✓
DC of California, Calcium Quiz (25)	32	✓	✓	✓	✓	✓	x	✓	x
Osteoporosis Society of Canada, Calcium Calculator (29)	29	✓ (Age group)	✓	✓ (SI unit also available)	✓	x	x	✓	✓
OWH[b], CDC[c], NOF[d], Powerful Girls Have Powerful Bones (30)	10 (diet and PA[e])	x	✓	x	✓ (no calcium value)	✓	✓	x	✓ (also for PA)
Kraftfoods, Calcium Counter (28)	109	✓ (Age group)	✓	x	✓	x	x	x	✓
Australian Consumers' Association (24)	41	x	✓	x	✓	x	x	x	✓
Unipharm Inc. (31)	46	✓ (Age group)	✓	✓	✓	x	x	x	x
GlaxoSmithKline, Calcium Calculator (26)	100	✓	✓	✓	✓	x	x	x	x
Kaiser Permanente, Calcium Counter (27)	50 (sort food first)	✓	✓	✓	x	✓	x	x	x

[a]DC, Dairy Council
[b]OWH, Department of Health and Human Services' Office on Women's Health
[c]CDC, Center of Disease Controls of United States
[d]NOF, National Osteoporosis Foundation
[e]PA, Physical activities
✓, Feature available
x, Feature not available

Investigators of the W-191 project developed a food frequency questionnaire (FFQ) containing a food list of 80 foods. These foods 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 have been reported to replace milk and other high-calcium foods.

Later, investigators of this project extended the W-191 FFQ for use in the Adequate Calcium Today Study to evaluate calcium intake among multiethnic youth along with the integration of nutrition education about the importance of calcium in preventing osteoporosis.

ADEQUATE CALCIUM TODAY (ACT) STUDY

The ACT Study was a 5-year, multistate, USDA-funded Extension project. This targeted behavioral intervention was designed to improve calcium intakes and bone health among Asian, Hispanic, and White youth, likely reducing their risk for osteoporosis later in life. It integrates multiple components: behavior theory, dietary assessment, psychological moderators (motivators and barriers), genetic, physiological assessment (bone accretion, body composition, lactose intolerance), and multimedia development. The five specific aims of this project were:

1. Establish a technologically driven behavioral intervention program that can be readily expanded to meet the needs of education professionals, health care

providers, and health and nutrition educators on a national basis,

2. Recruit 1200 healthy 11- to 12-year-old females equally divided between Asian, Caucasian, and white Hispanic youth from seven states for participation in a 2-year behavioral intervention designed to increase calcium intake thereby enhancing the rate of increase in bone mineral density. Intervention sites would be aligned with schools, 4H programs, health maintenance organizations, after school programs, and community centers. Subjects would be randomly assigned to intervention or no intervention,
3. Measure occurrence of lactose maldigestion among healthy 11- to 12-year-old females representing three ethnic groups (Asian, Caucasian, and white Hispanic),
4. To demonstrate by psychological assessment measures, the advantages of applying predictive schemes for targeted behavioral intervention, and
5. To determine whether genetic markers can define subgroups of adolescent girls that have increased risk for lower bone mineral density due to decreased bone growth during adolescence; to determine whether the distribution of genetic markers in racial groups can explain racial differences in bone growth of adolescents; to determine whether the response (i.e., rate of bone growth) of adolescent girls to increased calcium intake is associated with their genetic profile.

Figure 1-1 shows an overview of the ACT Study protocol. Utah State University collaborated in this project as a subcontractor for developing food photos, and evaluating the electronic food frequency questionnaire.

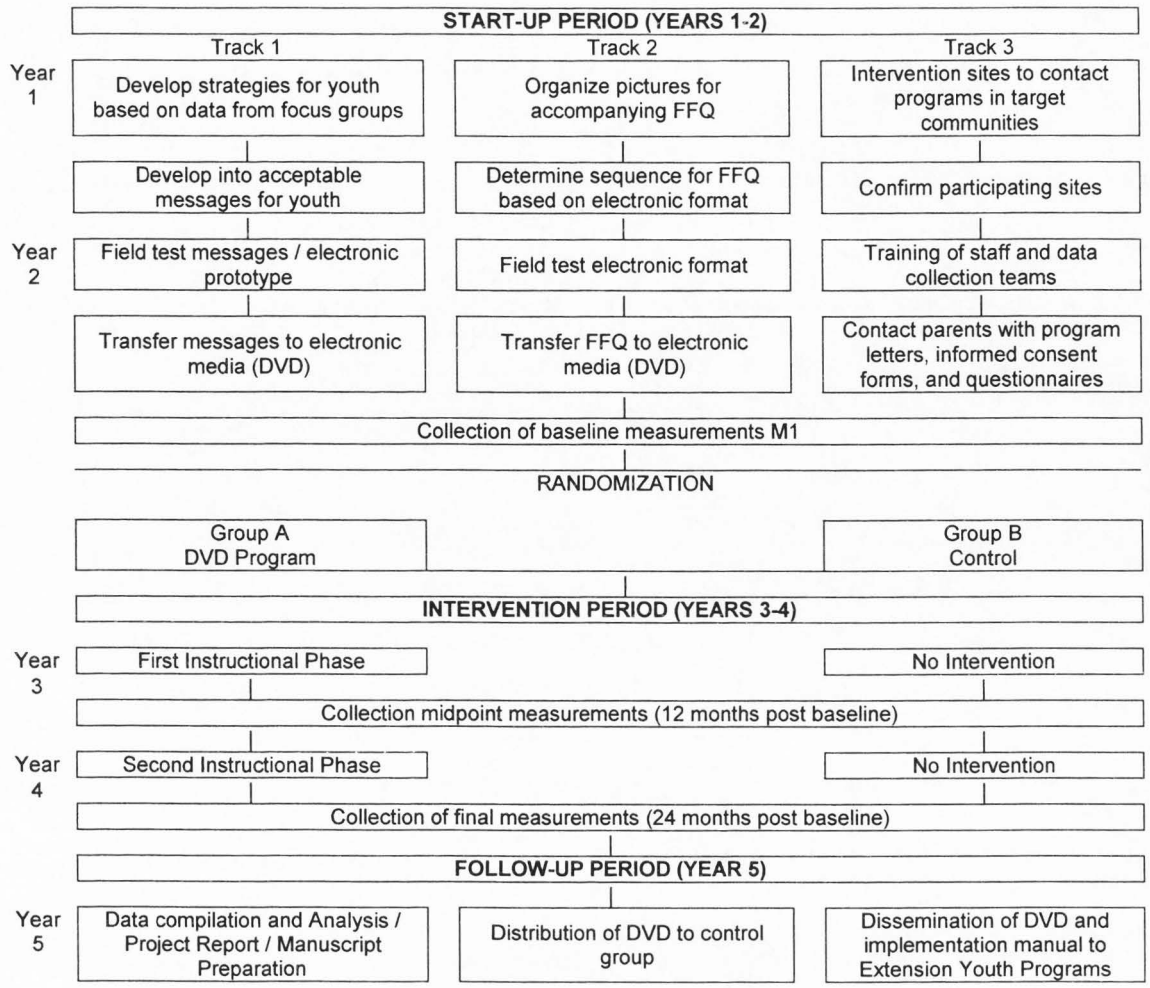

Figure 1-1. Protocol overview of the ACT study.

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CHAPTER 2

PRODUCTION AND EVALUATION OF FOOD PHOTOGRAPHS AND AN ELECTRONIC FOOD FREQUENCY QUESTIONNAIRE

INTRODUCTION

Food Graphics Versus Food Photos

An appropriate picture often helps to illustrate texts better. Pioneered by Hankins and colleagues (1), researchers have begun evaluating the effects of printed food graphics (2) or actual photos (3-7) in cueing respondents to report food choices and intake frequencies, or using a photographic atlas of food portion sizes to estimate portion sizes (8-14). Among reported studies, some have included adolescent participants (2, 8, 10, 15, 16). FFQs, administered in combination with food pictures, and compared to two or more 24 hour-dietary recalls, have reported correlation coefficients ranging from 0.26 to 0.87 for macronutrients, selected vitamins and minerals with or without calcium and fiber (3-7).

What about digital food graphics or actual photos displayed directly on a computer monitor screen? Hampl and colleagues initiated adoption of digital photography in dietary assessment (17); and the United States (U.S.) Department of Agriculture (USDA) and the Centers for Disease Control and Prevention (CDC) have expanded upon this potential. USDA produced 59 interactive color food pictures online. This Food Image Gallery is in the public domain as a tool to understand food groupings and portion sizes (18). CDC has created a website specifically designed for adolescent girls to learn more about bone health through a graphic-oriented dietary

survey and many interactive games (19). "Clueless in the Mall", an interactive multimedia educational program, was developed to educate youth about calcium and osteoporosis through a virtual scavenger hunt setting (20).

Today, there is a growing interest among healthcare researchers in developing accurate and culturally-sensitive dietary assessment tools, that are also short, easily administered, and inexpensive for use across a broad range of youth subpopulations, either to estimate a specific nutrient or food intake, or diet of a target population. As the younger generation becomes more technologically savvy, and experiences more extensive exposure to multimedia, an interactive dietary assessment tool almost guarantees to be more engaging for adolescents and children compared to traditional paper-and-pencil questionnaires. With increasing high-quality, yet user-friendly products in digital photography, digital food photos can be produced more easily and economically. Life-size, color photos of actual foods used at face-to-face interviews can be cumbersome (21). Digital food photos that are incorporated into computerized dietary assessments are convenient to use and organize in meaningful ways, yet a lower cost and still serve as powerful visual aids in dietary surveys.

Interactive multimedia, computer-based programs are becoming more widely used because they are effective in educational programs (22). Computer-based dietary assessment tools are also becoming more popular. Not only are these tools convenient to use, but they are also more time- and cost- effective because less money is spent on printing questionnaires and a lot less time is spent on data entry and data cleaning.

Knowing whether a dietary assessment tool performs well in measuring a nutrient or dietary pattern among a target population is not enough. Rather, researchers

need to further evaluate the quality of each component of the tool in order to implement future improvements in the tool or develop a better one. With this, summative evaluation becomes a critical procedure to identify areas for improvement (23).

Formative and Summative Evaluations

An evaluation process consists of formative and summative evaluation. According to Bhola's definition (24), formative evaluation is a method of judging the worth of a program while the program activities are forming or happening. In other words, formative evaluation focuses on the process. Conversely, summative evaluation is a method of judging the worth of a program at the end of the program activities. It focuses on the outcome. Both procedures provide feedback to further improve a product or a service before, during, and/or after actual testing of the product or service.

Purpose of Study

In this study, the purpose of conducting formative evaluations of food photographs was to create a set of food photos, which portray multiethnic foods that are major contributors to calcium intake among a subpopulation of Asian, Hispanic, and White youth in the U.S. The purpose of conducting the summative evaluation of the electronic food frequency questionnaire (eFFQ) was to evaluate participants' overall acceptance and satisfaction toward the interactive multimedia, computer-based calcium assessment tool, which was used in the eFFQ Evaluation Study designed for multiethnic youth. In addition, summative evaluation of the eFFQ also aimed to identify areas for improvement in the eFFQ computer program and its administration.

METHODS

Food Photo Production and Evaluation

Selection of food photos was based on the food list that was the basis for the original paper-version of the W191 FFQ for measuring calcium intake. This food list contained 79 food items (single or grouped), and 100 single foods. In preparation for the food photography, a number of events occurred. First, each food item's definition or recipe was confirmed among the multi-center research team. Second, ready-to-eat food items and raw ingredients were purchased (often double or triple the portion size listed on the FFQ) from local markets, restaurants or through mail order, such as poi from Hawaii. Third, the food photo production team studied and practiced preparing dishes, especially ethnic foods (such as sushi and chili relleno), and presenting them as artistically as possible. It was especially challenging to present dishes with minimal amount or no garnish.0

Photo Session

All 79 food items (single or grouped) were digitally photographed at one to two constant angles using a digital camera, tripod, homemade light box, and either a piece of black velvet or a black foam board. Two standardized types of dinnerware (plain versus patterned) were used. Reference objects (such as spoon, fork, and measuring cup) were used to explore the helpfulness of providing more accurate and consistent visual aids to estimate portion sizes.

Each food picture contained either a single food or a combination of a similar type of food but different kinds, such as milk – white or chocolate. For each photo

session, foods were divided into two categories based on when photos needed to be taken to capture the best presentation of the food. These categories included: 1) dry or ready-to-serve foods that allow more time for presentation arrangement and photography, versus 2) foods that require prompt presentation arrangement and photography before any undesirable changes happen, such as melting (e.g., ice cream), absorbing (e.g., waffle with pancake syrup), drying (e.g., cooked vegetables), collapsing (e.g., whipped cream on pie), cooling (e.g., hot tea), and fizzing-off (e.g., soda). Slight delays in photographing prepared foods in the latter category not only could lead to less-desirable photos but also additional effort, time, and money to repeat the entire process from preparation to photography, until a satisfying series of photos was produced. Foods that were most challenging to photograph (in terms of technique and time spent) include colloidal beverages (such as milk, yogurt drink, breakfast drink) in clear glass, ice cream, milkshake, hot food sprinkled with shredded cheese or topped with butter, and cream pies topped with whipped cream.

Another challenge was to eliminate any indications of a specific brand. The food-picture production team took this extra effort to avoid copyright issues and also not to promote any preference of a particular brand to the other. Therefore, generic labels for certain foods, such as soda and yogurt, were designed and created to disguise the actual brand name on the original container. Brand names on chocolate bars were digitally erased after the photo was taken.

Food Photo Cards

All photos were digitally edited by using Photoshop Elements (Adobe

Photoshop Elements 3.0 for Windows, San Jose, CA, 2001) and saved in the Joint Photographic Experts Group (JPEG) format. Each laminated food picture card contained information in front and back, that is a color print of the food in front, and the actual food name and portion size at the back. Each card was labeled with a code corresponding to the question numbered on the FFQ.

Participants

There were four rounds of formative evaluation. Each round consisted of a different focus group. Participants ranged from high-school students to university professors. Eighty-five Caucasian, Hispanic, Asian volunteers participated in this study. The majority were Caucasian and female. There were four female faculty members in Round 1, 41 dietetic students (three males and 38 females, age 19-46) and 10 Hispanic 9th-Graders (five males and five females) in Round 2, 30 research team members in Round 3, and a multimedia production team at New Mexico State University in Round 4.

Focus Group Administration

In Round One, four female professors who specialized in Nutrition-related fields evaluated the first 79 sets of food photos, which consisted of more than 220 food pictures Based on their feedback, up to four best pictures for each food item were selected.

In Round Two, each participant evaluated the second 79 sets of food photos (193 food pictures) by completing a formative evaluation questionnaire (Appendix A). They were asked to only evaluate photos of the foods which they knew and consumed.

First, the participants wrote their individual guess of the food name on the questionnaire based on what they saw on a food picture. Then, they flipped the food picture card over to read the actual food name and portion size. Finally, they chose the most appealing photo among multiple shots and were given an option to write their comments or suggestion on the representation and appeal of each food photo.

In Round Three, 30 research team members consisting of university faculty members, USDA and Dairy Council representatives evaluated the third 79 sets of food photos (100 food photos). Each picture was passed around the entire group and spontaneous comments were made and documented.

In Round Four, a multimedia production team at New Mexico State University (NMSU) evaluated the last 79 sets of food photos. A CD containing digital food photos was sent to NMSU. The team selected the single most appealing food photo for each question listed on the FFQ, which became the final selections for use in the production of an electronic FFQ. Figure 2-1 provides a pictorial summary of procedures mentioned above.

EFFQ Production and Evaluation

Design of the Summative Evaluation Questionnaire (SEQ)

The paper and pencil-format SEQ contained a combination of open- and close-ended questions. Parts 1 and 2 contained summative evaluation of two major components, i.e., 1) the eFFQ computer program, and 2) the final set of food photos. Later, Part 3, which investigated future improvements of the eFFQ, was added to the SEQ.

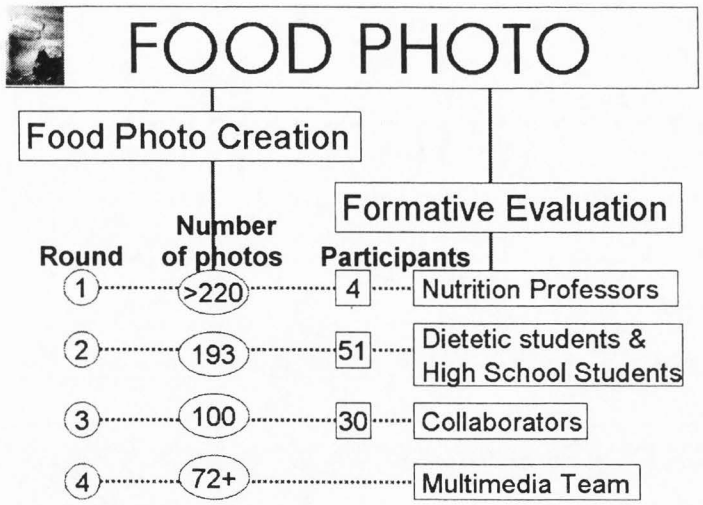


Figure 2-1. Summary of food photo formative evaluation.

In Part 1, the eFFQ computer program was evaluated regarding its ease of use, overall enjoyment to complete, level of interaction, and audio-visual quality. In addition participants were queried about personal likes and dislikes related to the eFFQ, and whether they had suggestions for future changes.

In Part 2, the final set of food photos were evaluated by the multiethnic youth who had actually completed two administrations of the eFFQ as part of the evaluation study. This evaluation incorporated the use of the computer monitor screen to show all of the digital food photos in exact sequence of how they appeared in the eFFQ. So when participants answered this second section of the SEQ in writing, they also viewed their own monitor screen and scrolled down as they evaluated food photos of the foods they knew and consumed.

In Part 3, we wanted to find out what features participants hoped to see in the next version of this eFFQ. A list of features focusing on narration, format of answering the eFFQ, and food photos were provided in the SEQ, in which participants were inquired to select all applicable features they hoped to see incorporated into the next

version of eFFQ.

Participants

A convenience sample of Asian, Hispanic, and White youth (11-18 years old), living in Northern Utah, who participated in the eFFQ Evaluation Study were recruited. One hundred sixty-six youth completed Parts 1 and 2 of the SEQ. A subset of 128 participants completed Part 3 of the SEQ. All of these participants had previously completed all four sessions of the eFFQ Evaluation Study.

SEQ Administration

Preparation. Fifteen to 30 minutes before the eFFQ2 session, moderators setup the test station by opening the food photo file and then, the eFFQ. The SEQ was placed facedown together with a set of pencils and erasers on each table. As participants came in for the final session of the eFFQ Evaluation Study, instructions for answering both the eFFQ and SEQ were given.

Survey Session. When a participant completed the eFFQ, he/she raised his/her hand to notify the moderator. While the participant remained seated, the moderator promptly exited the participant from the eFFQ and allowed the participant to proceed to answering the SEQ. When participants began to answer the first section of the SEQ, the moderator promptly maximized the food photo file on the monitor screen. These digital food photos were shown in exact sequence of how they appeared on the eFFQ.

Data Management

Responses to all close-ended questions were coded, entered, and verified

through double data entry. All comments and suggestions of open-ended questions were entered once only and then verified by a different person.

Statistical Analyses

Frequency counts and percentages were calculated to compare differences between gender, age group, and ethnic/race group. All statistical analyses were accomplished by using the SPSS statistical software for Windows (version 13.0, 2004, SPSS Inc, Chicago, IL). All bar charts were plotted by using Microsoft® Excel (Microsoft Office for Window XP, 2002, Microsoft Corporation, Seattle, WA).

RESULTS

Formative Evaluation of Food Photos

Table 2-1 shows the total sets of food photos used throughout the formative evaluation study. Participants in Round 1 selected up to four photos per food. These food photos were those with the best presentation and appeal in terms of appropriateness of food choice, shooting angle, food arrangement, choice of garnish and dinnerware.

Table 2-1. Number of food photo sets

Section	Number of Sets
Beverages	6
Dairy Products	12
Combination Foods	19
Vegetables, Grains, And Nuts	27
Seafood	5
Other Foods	10
TOTAL	**79**

Through this elimination process, 193 food photos were evaluated in Round 2. Participants in Round 2 further selected the best food photo per food item. Since the food photo production team was unfamiliar with Hispanic foods, a focus group with Hispanic participants was particularly helpful. Some of the valuable comments given are shown in Table 2-2. Based on the accuracy of guesses made on food name, food photos with more than 33% "wrong" or "somewhat correct" answers, were either re-photographed or eliminated if better alternative photos were available. In addition, food photos with poor resolution were also re-photographed using a higher-resolution digital camera. Table 2-3 shows a list of food items that were the hardest for our focus group to recognize from food photos.

Table 2-2. Tips for preparing and photographing Hispanic foods

Food Name	**Male**	**Female**
Chili Relleno	(No comments)	No melted cheese on top, more cheese inside the chili, use tomato sauce instead of enchilada sauce
Taco	Add cream, salsa, tomatoes	Remove the bell pepper as garnish; no pepper, add salsa, white cheese, keep sour cream
Quesadilla	No cheese on the top, just cheese inside	Looks like pita! Nothing sprinkled on top
Beef Enchilada	Take out the pepper, put sour cream, lettuce, and cheese	Put potatoes, chicken, sour cream, salsa (inside); sprinkle cheese on top
Tamales	Meat inside, homemade	Wrong appearance, no dressing (onion & pepper) on top, nothing on top.
Posole	(No comments)	Add cabbage (shredded), add oregano
Atole	(No comments)	Served hot in a mug, light-pink
Refried Beans	(No comments)	Sprinkle or melt a little cheese on top
Cheese Enchilada	Cheese inside, put beans in the middle	(No Comments)
Bean Burrito	No lettuce, no pepper, add salsa and chili	Sprinkle more cheese on top, add salsa

Table 2-3. Round 2 of Formative Evaluation. Foods that were the hardest to recognize from photos

Food Name	Rating[c]	No. of Evaluators	Error Rate (%)
Posole[a]	1	2	100[b]
Adzuki bean foods (e.g. mochi)	1	4	80
Poi (taro)	1	4	75
Tamale	1	2	67
Pita[a]	1	1	50
salmon or chum, canned	1	1	50
Oriental snack mix (e.g. Arare)	1	1	50
Cheese Spread	2	6	100
Polenta	2	5	100
Natto (fermented soybean)	2	3	50
Kimchee (pickled cabbage) [a]	2	2	75[b]
Quesadilla	2	2	33[b]
Cheese&cracker snack packs (e.g. Snackables)*	2	1	100
Hominy	2	1	50

[a]Better alternative shots available for replacement
[b]Multiple shots combined for calculate average error percentage
[c]1=Wrong answer, 2=Somewhat correct answer

Most of the Hispanic foods were re-photographed, especially the ones purchased at local restaurants because it was difficult to resize the serving size, and the food became messy when transferred to our standardized dinnerware. Therefore, when Round 2 ended, the food photo production team decided to learn how to prepare Hispanic dishes on our own. Figure 2-2 shows some pre- and post-evaluation samples of food photos.

One hundred food photos were evaluated at Round 3. Participants recommended three changes: 1) if possible, remove all reference objects; 2) limit one food per food item, including questions with multiple foods grouped together in the FFQ; and 3) change the food photo background from black to white. To meet the first recommendation, food photos with reference objects (such as spoon or fork) were re-photographed. To meet the second recommendation, a frequency count was performed

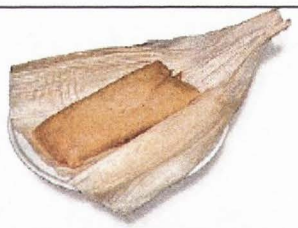
Food Name	Before	After	Changes Made
Chili Relleno			Coarsely shredded cheese was replaced with finely shredded cheese.
Taco			Sour cream, hot pepper, and more cheese were added.
Quesadilla			Sprinkled cheese and pepper were removed. Only cheese was melted inside.
Meat Enchilada			Instead of diced pepper, shredded cheese was the preferred garnish by Hispanic participants.
Tamale			Hispanic participants preferred to retain the corn husk.
Yogurt			Brand names were replaced by generic labeled container.

Figure 2-2. Example of food photo improvement: Pre- and post-formative evaluation appearance.

using the 24hdrs collected during the paper-version calcium FFQ evaluation study to identify the most frequently consumed food among multiple foods grouped together. For example, bread, toast, and pita were grouped together. Because bread was most frequently consumed by multiethnic youth in the evaluation study of the W191 FFQ, bread was chosen to be the food photo shown for that particular food item on the eFFQ. To meet the third recommendation, due to time limitation, most of the food photos were sent to NMSU for additional editing, i.e., to crop the photo from its black background and paste it to a white background with an added shadow effect. Food photos featuring beverages filled in clear glass were re-photographed with a white background.

In Round 4, finalized food photos along with the newly photographed beverage photos, were sent to NMSU in a CD-ROM with appropriate documentation. The multimedia production team evaluated the newest set of food photos featuring beverages. After they selected the single most appealing picture per beverage item listed on the FFQ, all food photos were edited and incorporated to the eFFQ.

Food Photo Summative Evaluation

When the final set of food photos were evaluated, no more than 6% of all participants considered a single food photo a "bad photo" (i.e., the participant knew the food but he/she could not recognize it from the photo). Table 2-4 shows the list of foods that were not recognized correctly by at least 33% of the participants who evaluated their food photos during formative evaluation. The reworked and improved photos had a much lower percent of error when evaluated in the summative evaluation.

Table 2-4. Part 2 of SEQ. Summative evaluation of final food photo set

	Summative Evaluation (n=166)
Food Item	**% Error**
Cheese Spread	3.6
Poi (taro)	3.0
Polenta	2.6
Adzuki bean foods (e.g. mochi)	2.3
salmon or chum, canned	2.1
Instant Breakfast Drink	1.8
Natto (fermented soybean)	1.4
Oriental snack mix (e.g. Arare)	1.4
Hominy	1.4
Tamale	0.6
Quesadilla	0.5

Although there was substantial improvement, we do need to consider the learning effect of the participants in better recognizing a food from the photo since these photos were shown in the eFFQ.

Nonetheless, soup or chowder made with milk; atole; and pudding, custard, or flan were the three photo sets being rated by all participants (including young vs. old) as the most difficult photos to recognize. Asian youth had the most difficult time recognizing the photo of soup or chowder made with milk (9.7%); Hispanic youth, the atole photo (5.3%); and White youth, the pudding, custard, or flan photo (8.9%).

EFFQ Summative Evaluation

One hundred seventy youth were recruited from the eFFQ evaluation study. Four participants (1 Asian and 3 Hispanics) were excluded in the final analysis because they withdrew without completing both 24hdrs and both eFFQs. The final study sample of 166 consisted of 84 males (50.6%) and 82 females (49.4%), of whom 29% were Asian, 39% were Hispanic or Latino, and 32% were White. Approximately one-half were 11-14 years old (n=85, 51% male and 49% female), and one-half were 15-

18 years old (n=81, 51% male and 49% female).

Rating of the eFFQ sorted by ethnic/race group and gender (Category A) versus ethnic/race group and age group (Category B) is presented in Appendix C. Overall, 75% of participants, especially White females (96%) and more 15-18 year-olds (85%) than 11-14 year-olds (67%) among all ethnic groups, considered the eFFQ computer program very easy to use (Figure C1, a-b). Among the 45% of participants who considered the eFFQ very enjoyable, 65% were Hispanic males and 79% were 11- to 14-year-old Hispanic youth (Figure C1, c-d). More female than male participants (particularly Hispanics) considered the eFFQ very interactive. Most (73%) 11- to 14-year-old Asians considered it somewhat interactive. Interestingly, only males of any ethnic/racial group rated the eFFQ not interactive (Figure C1, e-f). One-third of all participants got bored during the eFFQ sessions. More 15-18 year olds (48.1%) reported getting bored than 11-14 year olds (27.1%). Male and female Hispanic youth consistently reported getting bored the least during the eFFQ sessions, compared to Asian and White youth (Figure C1, g-h). The overall sound quality was rated excellent or good by the majority of all subgroups, especially females among all ethnic groups (Figure C1, i-j). Almost all (91%) participants could understand everything that the narrator said during the eFFQ. Younger participants understood a little less well than the older participants (85% vs. 98%). The only young Asian male who reported not understanding what the narrator was saying during the eFFQ felt that the narrator spoke too slowly (Figure C1, k-l). Although we used a female voice in all narration, 97% participants considered the eFFQ appropriate for boys and girls and there were no differences between gender or age groups (Figure C1, m-n). As for font size displayed

on the monitor screen, 99% participants considered the fonts big enough to read (Figure C1, o-p).

Table 2-5 is a summary of the features participants liked best about the eFFQ. In decreasing order, the top three components of the eFFQ that youth liked the best were food photos (23%), ease of use (21%), and the positive impact (such as dietary awareness) and enjoyment that resulted from answering the eFFQ (18%).

Table 2-6 is a summary of the features participants liked least about the eFFQ. In decreasing order, the three features of the eFFQ that youth liked the least were the narration (30%), answering format (25%), and the way instructions and explanations were given (14%).

When asked about what things they would like to see changed on the eFFQ, 40% of participants thought no changes were needed. Among the 60% who thought changes should be made to the eFFQ, the top three components that they hoped to change, in decreasing order, were the narration (16%), food list (15%), and the overall eFFQ computer program (10%). Only 4% of suggested changes were related to food photos, which indicated potential favor in using food photos in eFFQ. A summary of all suggestions for changes is listed in Table 2-7.

Figure C2 in Appendix C depicts a series of responses sorted by ethnicity and gender versus ethnicity and age groups. Seventy-six percent of all participants (equal proportion of male and female, 11-14 years old and 15-18 years old) hoped to have a shorter narration in the next version of the eFFQ (Figure C2, a-d). Approximately half the participants, with males' preference greater than females' among all ethnic groups, hoped to have faster narration in the future (Figure C2, e-h). Additionally, about

Table 2-5. (Q9) What did you like the best about the eFFQ?

Summary	Count		Percent		Valid Percent	
Questionnaire Design	**65**		**33.6**		**35.4**	
Overall Design	13		6.7		7.1	
Ease of use	39		20.2		21.2	
Simple: easy to understand, easy to answer		34		17.6		18.6
Convenience - listening instead of reading		3		1.6		1.6
Computerized, opportunity to use computer		1		0.5		0.5
User friendly, interactive		1		0.5		0.5
Program Speed	6		3.1		3.3	
Fast, quick		4		2.1		2.2
Answer at own pace		2		1.0		1.1
Instruction	7		3.6		3.8	
Clarity (clear, concise, straightforward, easy)		6		3.1		3.3
Answering example provided		1		0.5		0.5
Question	16		7.4		8.7	
Variety of Calcium-rich food, ethnic food included		8		4.1		4.4
Design		3		1.6		1.6
Freq options		3		1.6		1.6
Food grouping		2		1		1.1
Audio	**12**		**6.3**		**6.5**	
Overall sound quality	4		2.1		2.2	
Narration	8		4.2		4.3	
Narrator's enunciation clarity & volume		4		2.1		2.2
Narrator's Voice		3		1.6		1.6
Good pause in narration (wasn't going on and on)		1		0.5		0.5
Visual	**42**		**21.7**		**22.9**	
Food Photos	42		21.7		22.9	
Quality appeal, resolution, realistic representation		30		15.5		16.4
Food photos clarified questions		11		5.7		6.0
Serving size shown		1		0.5		0.5
Impact, Emotion	**33**		**17.1**		**17.9**	
Becoming aware of own dietary intake, food choices, eating habits, calcium intake		17		8.8		9.3
Fun, enjoyable, not boring		9		4.7		4.9
Motivated to eat better		4		2.1		2.2
Learn new foods		1		0.5		0.5
Attend survey once a week		1		0.5		0.5
New places to visit		1		0.5		0.5
Administrative	**15**		**7.9**		**8.2**	
Good equipment: Laptop/computer		3		1.6		1.6
$25 Incentive for completing all four sessions		4		2.1		2.2
Snack provided at the end of each session		4		2.1		2.2
Interviewers		4		2.1		2.2
Subtotal	**183**		**94.8**		**100.0**	
(No comments)		5		2.6		
Related to 24-hour dietary recall interviews		5		2.6		
TOTAL	**193**		**100.0**			

Table 2-6. (Q10) What did you like the least about the eFFQ?

Summary	Count	Percent	Valid Percent
Questionnaire Design	**61**	**34.7**	**49.8**
Everything	1	0.6	0.8
Program Speed	12	9.9	9.9
A bit slow	4	2.3	3.3
Slow, really slow	4	2.3	3.3
Too slow	4	2.3	3.3
Answering	31	17.6	25.2
Unknown food	8	4.5	6.6
Question	7	4	5.7
Recall dietary intake	6	3.4	4.9
Can't go back to change answer	2	1.1	1.6
Multiple choices; repeating answer choices	2	1.1	1.6
Too many questions	2	1.1	1.6
Food not consumed last month	1	0.6	0.8
Lack of certain frequency options	1	0.6	0.8
Lack of food selection	1	0.6	0.8
No help to define unknown words	1	0.6	0.8
Instruction/Explanation	17	9.6	13.9
Too long	5	2.8	4.1
Can't skip instruction at the beginning	3	1.7	2.5
Repetitive between food sections	3	1.7	2.5
Can't skip in Introduction/Between sections	2	1.1	1.6
Slow in Introduction/between sections	2	1.1	1.6
Example in Introduction (Soda)	1	0.6	0.8
Too specific/Too easy	1	0.6	0.8
Audio	**36**	**20.5**	**29.5**
Narration	36	20.5	29.5
Slow/Too slow	6	3.4	4.9
Narrator's voice gets annoying after a while	5	2.8	4.1
Repetitive	5	2.8	4.1
Talk too much	4	2.3	3.3
Overall	3	1.7	2.5
Can't skip narration	3	1.7	2.5
Time-consuming/Too Long	3	1.7	2.5
Monotonous, lack enthusiasm, boring	2	1.1	1.6
Incorrect pronunciation of food name	1	0.6	0.8
Odd inflections (Strong/wrong emphasis in words)	1	0.6	0.8
Read the whole question	1	0.6	0.8
Soft	1	0.6	0.8
Voice sounded funny/old at times	1	0.6	0.8
Visual	**4**	**2.4**	**3.2**
Food Photos	4	2.4	3.2
Overall	1	0.6	0.8
Some foods are hard to recognize from pictures	1	0.6	0.8
Specific food (Spinach/Coffee/Tea/Meat	1	0.6	0.8
Screen: Font is small	1	0.6	0.8

Table 2-6 (Continued)

Summary	Count	Percent	Valid Percent
Impact, Emotion	**15**	**8.5**	**12.3**
The session is a little long/Long/Too long	6	3.4	4.9
Boring	5	2.8	4.1
Boring after a while/sometimes	3	1.7	2.5
Impact: Realize the need to eat better/realize not eating well	1	0.6	0.8
Administrative	**6**	**3.5**	**4.9**
Finding the survey location	1	0.6	0.8
Not enough candy (food incentive)	1	0.6	0.8
Equipment: Slow computer, lag time (sound comes late)	4	2.3	3.3
Subtotal	**122**	**68.9**	**100.0**
Blank	2	1.1	
NA (No comments)	45	25.4	
NA: 24hdr-related	7	4	
Don't know	1	0.6	
TOTAL	**177**	**100.0**	

Table 2-7. (Q11) What things would you like to see changed in the eFFQ?

Summary	Count	Percent	Valid Percent
No comment. All is good. No changes needed	72	40.2	41.6
Computer Program Design and Speed	**18**	**10.4**	**10.6**
Program Speed: Faster	8	4.5	4.6
Computer Program Design	10	5.9	6.0
Add animation: e.g., character, sound effect	2	1.1	1.2
Overall	1	0.6	0.6
Add different graphics	1	0.6	0.6
Add other educational information	1	0.6	0.6
Increase interaction	1	0.6	0.6
Make it more efficient	1	0.6	0.6
Make it more interesting, exciting or fun	1	0.6	0.6
More kid-friendly	1	0.6	0.6
Need to be more age-appropriate	1	0.6	0.6
Food List	**26**	**14.8**	**15.3**
Add more variety of food	11	6.1	6.4
Change/allow for more frequency options	5	2.8	2.9
More of other ethnic foods	2	1.1	1.2
Add different kinds of pastas	1	0.6	0.6
Add/more fruits	1	0.6	0.6
Change the questions	1	0.6	0.6
Less Mexican food, esp. for the ones who do not eat them	1	0.6	0.6
Fewer number of questions	1	0.6	0.6
Make each question read shorter yet remain specific	1	0.6	0.6

Table 2-7. (Continued)

Summary	Count	Percent	Valid Percent
Food List (continued)			
More American food	1	0.6	0.6
Survey food by ethnic food category	1	0.6	0.6
Instruction/Explanation	**8**	**4.5**	**4.7**
Repeat explanation less often; keep instruction brief	3	1.7	1.7
Overall	2	1.1	1.2
Option (shortcut key) to skip repetitively long explanation, move directly into the next section	2	1.1	1.2
Make instruction more entertaining	1	0.6	0.6
Answering	**9**	**5.2**	**5.2**
Add a BACK button	3	1.7	1.7
Add background music/More music	3	1.7	1.7
Add a Dictionary button	1	0.6	0.6
Make frequency options consistent with frequency interval and assign an alphabet to each option	1	0.6	0.6
Add an option to default all answers to NEVER if a food section was not consumed at all in the past month	1	0.6	0.6
Audio	**28**	**15.8**	**16.3**
Narration			
Shorten narration/Talk Less	7	3.9	4.0
Narrate faster	5	2.8	2.9
Find a better narrator	3	1.7	1.7
Option to skip narration	3	1.7	1.7
Better sound	2	1.1	1.2
Option to mute narration	2	1.1	1.2
Use more than one narrator/Alter w question	2	1.1	1.2
Change the voice a little	1	0.6	0.6
Correct strong/wrong emphasis in words; inflection	1	0.6	0.6
Faster (shorter talk) between section	1	0.6	0.6
Remove the narrator	1	0.6	0.6
Visual	**7**	**4.0**	**4.2**
Food Photos			
Improve some of the photos	2	1.1	1.2
Use more pictures	2	1.1	1.2
Each picture shows an exact serving size	1	0.6	0.6
Use different pictures/new pictures	1	0.6	0.6
Display: Larger font	1	0.6	0.6
Administrative	**5**	**2.8**	**3.0**
Equipment: Use faster computers	2	1.1	1.2
Provide more snack as incentive	2	1.1	1.2
Change the time of the sessions	1	0.6	0.6
Subtotal	**173**	**96.6**	**100.0**
Related to 24hdr	2	1.1	
NA – Irrelevant	2	1.1	
Don't know	2	1.1	
TOTAL	**179**	**100.0**	

two-thirds of participants hoped to have an option to skip the narration during the survey (Figure C2, i-j). Compared to all males or 15-18 years old participants, females or the 11-14 year-olds had a slightly greater interest in using a combination of female and male voices of narration in the next version (Figure C2, k-p). Regarding the format of answering in the next eFFQ version, 75% of all participants would like to be able to move backward and forward to change or check their answer (Figure C2, q-r). Removal of the animated example (Figure C2, s-t) and sorting of food (Figure C2, u-v) did not matter much. Most considered the food photos shown on screen was large enough for viewing (Figure C2, w-x). For food photos used in the next eFFQ version, Hispanic females (70%) particularly, and more 15- to 18-year-old participants than 11- to 14-year-old participants hoped to see photos of all the foods asked in one question (Figure C2, y-z). Use of garnish, colorful dinnerware, or a different background color in food photo production did not matter much to the participants (Figure C2, aa-ab). More than 80% participants considered the color of dinnerware and food photo background appropriate (Figure C2, ac-af).

From the administrative standpoint, the eFFQ was very easy to administer and data collection effort was minimal except that study staff must take extra precaution with file naming and saving immediately upon completion. The eFFQ runs well in any processor equal or greater than 486, making the hardware requirement minimal.

We learned that participants whose siblings or close peers or friends attended the same survey session tended to compete with each other to finish sooner, which increased the chance of response errors. Therefore, it helped to schedule siblings or close friends during different survey sessions, or at least in distant seats from each

other if they attended the same session, which happened very often in this study. We also realized that when some of the participants turned their head and looked around during the eFFQ session, they were not really bored but it was natural to look around when instructions and questions were narrated throughout the eFFQ.

DISCUSSION

Formative Evaluation

Several strengths were evident in the results from the formative evaluation study. First, food photos were evaluated by multiethnic focus groups for quality of representation and artistic arrangement, and refined until satisfactory. Second, food photos uniquely featured multiethnic foods, especially combination foods, which have heretofore not been available for estimating calcium intake among multiethnic youth. Third, each food photo showed the exact portion size at which it was queried (a standard portion size), which provided additional visual reference for respondents to estimate the amount of food they consume. Showing actual serving sizes might prevent over- or underestimation of food intake as respondents tend to overestimate or underestimate if the food picture does not show an exact amount of food consumed (25). Fourth, comparing portion sizes was easy because all foods were photographed at a constant angle against a similar background on standardized dinnerware. Finally, actual food photos are more engaging since they look more appealing and realistic compared to graphic drawings of foods.

Food photos became even more useful in helping multiethnic youth identify foods they consumed when they were not sure about the actual food name.

Furthermore, food photos also exposed youth to names and appearances of other calcium-rich ethnic foods that they did not yet know, or had heard friends with different ethnic backgrounds mention. Hopefully, through this exposure, youth may increase their awareness for new foods that their peers enjoy eating, thus being motivated to try new foods shown on the eFFQ.

Despite these apparent strengths, limitations were also apparent in the formative evaluation study. First, since a convenient sample was used, not all of the focus-group participants in this study were 11- to 18-year-old multiethnic youth. Most of them were White females and all of them were Utah residents of Cache County and Salt Lake County. Second, use of white dinnerware caused a few photos to have rather poor contrast (e.g., chowder, white rice, cottage cheese).

In the formative evaluation study, there were a number of changes during the photo production process that could be avoided in the future. For example, if decisions about background color, choice of dinnerware, exclusion of reference objects and brand names, and the number of pictures shown per question, were clarified initially, then the entire process would have been more time and cost-effective. Nonetheless, we now have a final set of food photos representing multiethnic foods that appear to be well liked by youth and may be used to form the basis for further research. These photos are also versatile enough to be added to a larger compilation of ethnic food photos that can be used to study other nutrients in large epidemiological populations.

Compared to Asians and Whites, Hispanic youth considered the eFFQ most enjoyable and interactive to use. Notably, Hispanic youth also had the highest correlation coefficient between the first and second eFFQs among all ethnic groups

(refer to Chapter 3). Perhaps, similar to what Bock and colleagues (26) observed, literacy barriers could have been overcome by the audio instructions and questions together with photographs, which enhanced understanding.

Summative Evaluation

The summative evaluation of food photos involved greater number and more diverse participants, which allowed us to compare the differences between ethnic, gender, and age groups. A few ethnic food photos, such as atole and refried beans may still need to be retaken for future improvement. Since there were more 15- to 18-year-old participants than 11- to 14-year-old participants who reported getting bored during the eFFQ session, the level of interaction should also be explored more extensively.

The major strengths of the summative evaluation study are that all of the 166 participants who completed the eFFQ also completed a summative evaluation of this computer program and its food photos. Moreover, the SEQ was specifically designed to evaluate the eFFQ. Use of opened-ended questions allowed room for participants to provide subjective answers. Nonetheless, limitations exist. Due to time limitations, a formative evaluation of the eFFQ could not be conducted, which would have edified the findings from the summative evaluation. The other limitation of this study was that not all of 166 participants evaluated Part 3 of the SEQ.

Compared to other evaluation studies using interactive multimedia, computer-based dietary questionnaires and/or nutrition education programs (22, 26-29), the eFFQ performed comparably well. Not only both the dietary questionnaire and soap-opera series on calcium intake and osteoporosis were highly acceptable to participants, but it

was also considered gender- and age-appropriate for estimating calcium intake and educating multiethnic youth about the importance of calcium intake in preventing osteoporosis.

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CHAPTER 3

EVALUATION STUDY OF THE EFFQ FOR ESTIMATING CALCIUM INTAKE AMONG MULTIETHNIC YOUTH

INTRODUCTION

Adequate calcium intake is important for the attainment of peak bone mass and bone density until the fourth decade of life. This process peaks in adolescence (1). High calcium (2, 3) or milk (4-7) intake during adolescence is strongly associated with better bone health and a lower risk of developing osteoporosis and related fractures in later life across many ethnic groups (8). Today, inadequate calcium intake is becoming a potential nutrient deficiency problem in developed countries (9). Unfortunately, calcium intake in the United States (U.S.) is also inadequate, especially among female youth (10-12).

With this, increasing attention has been given to calcium intake assessment among youth. One of the most widely used methods is the food frequency questionnaire (FFQ), and thus far, there have been several FFQs designed for youth that specifically estimate calcium intake only (13-20) or intake of calcium and other nutrients (21-27). In this era of computer-assisted education, youth become increasingly savvy with computers at younger and younger ages. As a result, it instigated the development of computerized dietary assessment tools for use in research settings. A few computerized, self-administered FFQs have been reported to be reproducible and comparable to 'gold standard' dietary assessment tools such as 24-hour dietary recall (24hdr), food diaries, and weighed food records (28-31). Level of reproducibility of an FFQ is determined by the correlation between the first FFQ and the second FFQ, with an interval ranging from

a month to usually a year, and 24hdrs administered between the first and the second FFQs. Level of reliability of an FFQ is determined by the correlation between the second eFFQ and the average of 24hdrs. The reason for using the second FFQ instead of the first FFQ to correlate with the average of 24hdrs is that an FFQ assesses dietary data retrospectively, usually inquiring the respondent to recall intake frequencies of a list of foods he/she consumed in the past month. With this protocol, the second FFQ actually captures diet of the past month, which is also recorded in 24hdrs.

To date, although there are web-based calcium FFQs (some were even designed for youth) (32-40), there is no evaluated self-administered, electronic FFQ (eFFQ) specifically designed to estimate calcium intake among youth. Therefore, the purpose of this study was to evaluate an electronic version of a previously evaluated FFQ (14) designed to estimate calcium intake, among Asian, Hispanic, and White youth that was developed as part of a multistate U.S. Department of Agriculture (USDA) project to improve bone health among youth. An electronic dietary assessment tool for youth may allow better estimation of calcium intake and subsequent osteoporosis risk, and may also be effective for assessing dietary intervention strategies to improve bone health among youth.

METHODS

Creation of the Electronic Food Frequency Questionnaire

An eFFQ for estimating calcium intake was created based on a traditional paper-and-pencil FFQ that was previously developed and evaluated among youth from ten

Western states in America (14). Researchers of the W191 Project[1] compiled a list of 80 foods that were considered to supply substantial amounts of calcium to the diets of Asian, Hispanic, and White youth. This list was converted to a semi-quantitative FFQ that was evaluated among multiethnic youth in six Western states (Arizona, California, Hawaii, Idaho, Nevada, and Washington) (14). Standard portion size from national dietary survey was used. Finally, an electronic version of this FFQ that included food photographs, audio narration, graphics was produced.

Food Photos

Color digital photographs of each food, at the portion sizes listed on the original FFQ, were taken. Prior to producing the final eFFQ, each food photograph was formatively evaluated by focus groups. Final food photo selection was approved by the multi-center research group. The background for all food photographs was standardized. Foods were placed on a white serving dish, and beverages in a clear glass against a white background. Minimal garnish was added to a few foods. Food items on the FFQ that included more than one kind of food were represented by the photo of the single most frequently consumed kind listed as part of the food items.

Questionnaire Design

For each food, the commonly used portion size represented in the photo was

[1] The W191 Project was a USDA-funded, multi-state project that researched on factors influencing the intake of calcium rich foods among adolescents. Ten universities collaborated in this study. They were (1) the University of Hawaii at Manoa, Honolulu, Hawaii; (2) Purdue University, West Lafayette, Indiana; (3) New Mexico State University, Las Cruces, New Mexico; (4) Washington State University, Pullman, Washington; (5) Colorado State University, Fort Collins, Colorado; (6) University of California, Davis, Davis, California; (7) University of Idaho, Moscow, Idaho; (8) Utah State University, Logan, Utah; (9) University of Arizona, Tucson, Arizona; and (10) University of Nevada, Reno, Nevada.

listed along with a question asking how often, on average, the food portion was consumed over the past month. Each question had between four and seven frequency responses, which ranged from "Never or less than once per month" to "Four or more servings per day." Actual frequency categories varied depending on the food item. Questions about multivitamin and mineral, calcium, and protein supplement intakes were also included.

eFFQ Development

The eFFQ was developed at New Mexico State University where food photos, graphics, audio recording and written components were incorporated into a compact disc. A few screen shots from the eFFQ are available in Appendix B.

Participants

A convenience sample of 11- to 18-year-old Asian, Hispanic, and White youth in Cache and Salt Lake counties in Utah were recruited for the study. Participants were recruited through schools, churches, the Department of Nutrition and Food Sciences Dairy Bar at Utah State University, youth clubs using fliers, radio advertisements, and word-of-mouth. Participants and their parents or legal guardians were required to provide written consent for data collection according to guidelines outlined by the Utah State University's Institutional Review Board. Introductory letters and consent forms were available in Spanish and in English for the parents or legal guardians to read and sign. There was no translation into Asian languages because all participants and their parents r legal guardians spoke English and could complete the study in English without difficulty.

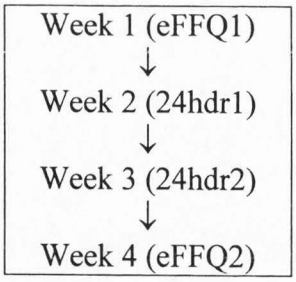

Figure 3-1. Survey design for the eFFQ evaluation study.

Study Design

Data were collected from October 2002 to June 2003. Each complete round of evaluation spanned four consecutive weeks (Figure 3-1). The first administration of the eFFQ (eFFQ1) was completed during week 1, followed by the first 24hdr (24hdr1) during week 2, the second 24hdr (24hdr2) during week 3, and the second administration of the eFFQ (eFFQ2) during week 4. Trained interviewers consisted of Whites, Hispanics/Latinos, and Asians, who were capable in interviewing multiethnic participants using English, Spanish, and/or Chinese (Mandarin and Cantonese).

eFFQ Administration

Participants completed the eFFQ in computer labs on the Utah State University campus or at home using laptop computers. In the computer lab, participants were scheduled for 30-minute sessions, with a maximum of 15 participants per session. Each participant wore a headphone throughout the eFFQ session so that each could clearly listen to all narrations. All eFFQs were self-administered but moderators were present to answer questions. Before each session began, participants were briefed not to discuss their answers with anyone throughout the session and to complete the eFFQ to the best of

their knowledge. They were also reminded that the eFFQ did not provide an option for them to change their answers once they clicked on a frequency of intake for a given food item; and that once they selected a frequency of intake, they would automatically advance to the next screen containing a different food item. After each participant completed the eFFQ, the frequencies of foods consumed were automatically outputted from the program into individual ASCII files. Before each participant left the computer lab, eFFQ responses were checked for the following: 1) total calcium intake indicated in the output file, 2) pattern of responses, and 3) total completion time. eFFQs with extreme values of calcium intake, invariable responses for all food items, and/or very short completion times were flagged. Upon agreement, three participants completed the eFFQ again immediately after these problems were detected.

24-Hour Dietary Recalls

All 24hdrs were collected by trained interviewers on an individual and face-to-face basis, using the Multiple-Pass Method developed for the 1994-1996, and 1998 Continuing Survey of Food Intakes by Individuals (CSFII) (41). An overview and justification of our modified CSFII methodology has previously been described (14) (see Appendix C for modified format). Food models (NASCO®, Ft. Atkinson, WI), dinnerware and a grid board were used to aid portion size estimation.

We used the Food Processor® (version 7.9, 2002, ESHA Research, Salem, OR) nutrient analysis system to enter and analyze all 24hdrs. In addition, the calcium value assigned to each food item by the Food Processor® was checked by the data entry person. Calcium values of newly-fortified foods were updated; USDA calcium values

were applied to generic foods; and international nutrient databases were also used, primarily for Asian foods. If brand names were reported, then the calcium value supplied by the manufacturer on the Nutrition Fact Label was used. Unique ethnic foods, such as Xiāng-Chù (Oriental dark, rice vinegar), was entered as closely as possible using the all available nutrient data on the manufacturer's label. New recipes were created for mixed dishes that could not be found in the ESHA database (e.g., homemade stir-fried vegetables, oriental dumpling).

Statistical Analysis

Distributions of raw data were examined using residual analyses. Skewed variables were transformed to approximate normal distributions using the Ladder of Transformation. Mean calcium intakes by sex, age group (11-14 versus 15-18 year olds), and ethnicity were compared using paired t-tests (α=0.05). Correlations between calcium intakes based on raw data were analyzed using Spearman correlations, whereas transformed or normalized data were analyzed using Pearson correlations. To adjust for within-person variation in calcium intake, deattenuated correlation coefficients were calculated using this formula (42):

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

where r_t is the true Pearson 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 (value used is that used in Jensen et al. (24)), and n=2.

Percent agreement was calculated to assess the ability of the eFFQ to classify respondents into similar quartiles of calcium intake with repeat administrations, and to

compare eFFQ2 and the mean of the 24hdrs (Avg24hdr). All statistical analyses were accomplished by using the SPSS statistical software for Windows (version 13.0, 2004, SPSS Inc, Chicago, IL).

RESULTS

One hundred seventy youth participated in the evaluation study. Four participants (1 Asian and 3 Hispanics) were excluded in the final analysis because they withdrew without completing both 24hdrs and both eFFQs. Five other participants (3 Hispanics and 2 Whites) were excluded in the final study due to missing data. The final study sample of 161 consisted of 81 males (50.3%) and 80 females (49.7%), of whom 29% were Asian, 36% were Hispanic or Latino, and 35% were White. Approximately one-half were 11-14 years old (n=86, 54% male and 46% female), and one-half were 15-18 years old (n=75, 53% male and 47% female). Table 3-1 describes the demographic characteristics of the sample stratified by sex, age group, and ethnicity. Seventy-eight percent of recalls represented weekdays and 22% represented weekends.

Daily calcium intake from food only (excluding supplements) estimated by each eFFQ and 24hdr is presented in Table 3-2. Interestingly, calcium intakes estimated by eFFQ1 are significantly higher than those estimated by eFFQ2 ($p<0.05$ for the entire

Table 3-1. Demographic descriptions of 161 participants completing the eFFQ evaluation study

	Male		**Female**	
Ethnicity	**11-14 years**	**15-18 years**	**11-14 years**	**15-18 years**
Asian	11	11	14	11
Hispanic	19	13	12	14
White	14	13	16	13
Subtotal	44	37	42	38
Total	81		80	

Table 3-2. Mean calcium intakes (mg) reported in two eFFQs and mean of two 24hdrs

Subgroup	n	eFFQ1 (Mean ± SD[a])	eFFQ2 (Mean ± SD)	Mean of both 24hdrs (Mean ± SD)
Sex				
Male	81	1,361 ± 602[bg]	1,143 ± 701[b]	1,283 ± 597[e]
Female	80	1,056 ± 615[g]	945 ± 644	1,059 ± 548[e]
Age				
11-14 yr	86	1,269 ± 710	1,053 ± 780	1,085 ± 495[e]
15-18 yr	75	1,142 ± 508	1,035 ± 545[c]	1,271 ± 658[ce]
Ethnicity				
Asian	47	1,028 ± 509[f]	868 ± 432[e]	958 ± 416[h]
Hispanic	58	1,363 ± 791[f]	1,196 ± 904[e]	1,135 ± 677[e]
White	56	1,203 ± 470	1,036 ± 534[d]	1,389 ± 527[deh]
Total	**161**	1,210 ± 626[b]	1,045 ± 678[b]	1,172 ± 582

[a] SD = Standard deviation.

Within a row

[b] Means from the eFFQ1 and eFFQ2 sharing the same superscript differ significantly by [b]p<.05.

[c-d] Means from eFFQ2 and the mean of both 24hdrs sharing the same superscript differ significantly by [c]p<.05, [d]p<.001.

Within a column

[e-h] Mean between subgroup sharing the same superscript differ significantly by [e]p<.05, [f]p<.01, [g]p<.005, [h]p<.001.

sample and for males). This same trend was shown in the evaluation of the traditional FFQ. Based on Avg24hdr, age, sex, and ethnicity were related to calcium intake. Fifteen- to 18-year-old youth reported a higher mean calcium intake than 11- to 14-year-old youth (1272 mg/day vs. 1085 mg/day, $p<0.05$). Male youth consistently reported a higher mean calcium intake than females, particularly when based on eFFQ1 (1362 mg/day vs. 1057 mg/day, $p<0.005$) and Avg24hdr (1284 mg/day vs. 1060 mg/day, $p<0.05$). Based on eFFQ2 versus Avg24hdr, 15-to 18-year-old White males reported a lower calcium intake (1037 mg/day vs. 1390 mg/day, $p<0.05$). Compared to Asians and Whites, Hispanic youth consistently reported the highest mean calcium intake on the eFFQ, while White youth reported the highest mean calcium intake on 24hdrs. Mean calcium intake was

Table 3-3. Correlations between calcium intakes estimated using eFFQ1 and eFFQ2 administered during Weeks 1 and 4

		Sex		Age		Ethnicity		
Test	Total (n = 161)	Male (n = 81)	Female (n = 80)	11-14 yr (n = 86)	15-18 yr (n = 75)	Asian (n = 34)	Hispanic (n = 20)	White (n = 27)
Spearman	0.71	0.61	0.80	0.64	0.80	0.70	0.75	0.64
Pearson	0.66	0.49	0.81	0.61	0.77	0.67	0.66	0.58
Pearson, transformed[a]	0.72	0.59	0.81	0.66	0.82	0.73	0.76	0.61

[a]Pearson Transformed, variable transformed using the Ladder of Transformation to improve normality. Transformed eFFQ1 and eFFQ were eFFQ1^0.25 and eFFQ2^0.23 respectively.
All correlation coefficients are statistically significant at $p<0.001$.

Table 3-4. Correlations of calcium intakes estimated using eFFQ2 and the average calcium intake from 24hdr1 and 24hdr2

		Sex		Age		Ethnicity		
Test	Total (n = 161)	Male (n = 81)	Female (n = 80)	11-14 yr (n =86)	15-18 yr (n = 75)	Asian (n = 34)	Hispanic (n = 20)	White (n = 27)
Spearman	0.51	0.48	0.47	0.47	0.54	0.57	0.50	0.45
Pearson	0.42	0.35	0.46	0.44	0.46	0.54	0.39	0.46
Pearson_T[a]	0.48	0.43	0.49	0.48	0.51	0.54	0.47	0.49
Pearson deattenuated[b]	0.49	0.41	0.54	0.51	0.54	0.63	0.45	0.54
Pearson deattenuated, transformed	0.56	0.50	0.57	0.56	0.59	0.63	0.55	0.57

[a]Pearson_T, Pearson correlation coefficients for transformed variables using Ladder of Transformation to improve normality. Transformed eFFQ2, average calcium intake from both recalls (Avg24hdr) were eFFQ2^0.23, Avg24hdr^0.45 respectively.
[b]Pearson deattenuated, Pearson correlation coefficients adjusted for within- and between-person variances.
All correlation coefficients are statistically significant at $p<0.001$.

the lowest among Asian youth using eFFQs or 24hdrs.

Correlations between calcium intake estimates collected using eFFQ1 versus eFFQ2, are shown in Table 3-3. The reproducibility of the eFFQ was higher among females versus males and among 15-18 year olds compared to 11-14 year olds. It also tended to be higher among Hispanics and lower among Whites. Correlations between calcium intake as estimated by eFFQ2 and Avg24hdr are shown in Table 3-4. The latter correlations also tended to be higher among females and among 15-18 year olds. These correlations were also higher among Asians compared to other ethnic groups.
Percent agreement between identical quartiles of calcium intake estimated by eFFQ1 and eFFQ2, eFFQ2 and Avg24hdr was 52% and 39% respectively. Agreement within ± one quartile for eFFQ1 and eFFQ2, and eFFQ2 and Avg24hdr was 87% and 83%, respectively.

DISCUSSION

This is the first study conducted to evaluate a computerized, self-administered, multimedia-assisted eFFQ for estimating calcium intake among a subpopulation of Asian, Hispanic and White youth in the U.S. The correlation between repeat FFQ administration (r=0.72) was high in the reported range (0.58-0.76) in comparable studies (13, 14, 24, 43). The correlation between eFFQ2 and Avg24hdr (r=0.56) also falls in the midrange of the reported findings (0.54-0.61) for FFQs designed to specifically estimate calcium intake among multiethnic youth.

Overall, the eFFQ performed well and is comparable to similar studies that were conducted among youth living in North America and Canada (13, 14, 24, 43), especially

to its parent paper version (14). Jensen and colleagues evaluated the parent paper version of this FFQ among 162 multi-ethnic, 10- to 18-year-old youth living in six Western states in the U.S. (Arizona, California, Hawaii, Idaho, Nevada and Washington). Correlation coefficient for reproducibility of the paper version FFQ was 0.68, and 0.54 for reliability. Another closely comparable study was conducted by Barr (13) in early 1990's. Barr evaluated an FFQ designed specifically to estimate calcium intake among youth. Participants were 130 urban Canadian high school students in grades 9 through 12 (14-17 years old). One-day food records were used to compare calcium intake estimates between and food records and the FFQ. Barr reported a correlation coefficient of 0.76 for repeated FFQ administrations and 0.59 for of the FFQ, which is comparable to what we observed from using the eFFQ. Another FFQ, the Youth/Adolescent Questionnaire (YAQ), was designed for youth to estimate calcium intake in addition to other nutrients based on the validated Nurses' Health Study FFQ. Rockett and colleagues (24) evaluated the YAQ among 179 multiethnic youth aged 9 to 18 years old. Participants completed the YAQ twice, a year apart. Correlations coefficient for reproducibility for calcium was 0.58. Later, the YAQ was evaluated among 261 multiethnic youth aged 9 to 18 years old (43). The YAQ was administered twice at an approximate interval of 1 year (1993-1994), together with three 24hdrs between the first and second YAQ administrations. Correlation coefficient for calcium intake estimated by YAQ and 24hdrs was 0.61 (deattenuated Pearson) for calcium.

The eFFQ served more effectively in estimating calcium intake among females and 15- to 18-year-old youth. One possible contributor was female participants in this

study who reported a higher mean calcium intake on eFFQs also took calcium supplement (Spearman ρ=0.35, p=0.002 for eFFQ1; Spearman ρ=0.26, p=0.02 for eFFQ2), which indicate that they would be more health-conscious consistently. The higher correlation for repeated eFFQ administrations and between eFFQ2 and Avg24hdr among 15-18 years old youth (for both sexes) was similar to the traditional trend, where older youth may tend to be more consistent in reporting their diet than do younger youth.

Among all ethnic groups, the correlation between eFFQ2 and Avg24hdr was the highest among Asian youth. The same trend was observed in the parent paper FFQ evaluated by Jensen and colleagues (14). The correlation between 24hdr1 and 24hdr2 was checked for each ethnic group. However, the correlation was the highest among Hispanics (ρ=0.51, p<0.01), followed by Asians (ρ=0.35, p<0.05) and Whites (ρ=0.31, p<0.05). Therefore, the consistency in dietary reporting did not contribute significantly to this observation. On the other hand, sampling pattern of 24hdrs may better explain this observation. Since the eFFQ reflects retrospective diet based on 24hdrs, (in this case, the eFFQ reflected diet of the past month, which included all days of a week), a balanced sampling of 24hdr on both weekdays (4 weekdays/7 days = 57% of sampling days) and weekend (3 weekend days/7 days = 43% of sampling days) would directly influence the correlation outcome. In other words, the closer a 24hdr sampling pattern meets this criterion, the greater the possibility of detecting a higher correlation between the second FFQ and the Avg24hdr. In this study, 56% of 24hdrs were collected from Asian youth during weekdays and 44% during weekends (including Sunday). For Hispanic youth, 85% 24hdrs were collected during weekdays, 15% during weekend; and for White youth,

91% weekdays and 9% weekend. Due to a rather narrow window of participants' availability and the distance between survey sites (e.g., Logan and Murray), the unequal proportion of sampling days among ethnic groups was inevitable. For future investigation, researcher may want to consider scheduling their 24hdr interviews evenly throughout a week.

Mean calcium estimated in eFFQ1 was higher than that in eFFQ2 for total samples and among males. Similar trend have been observed in evaluation of traditional FFQ. This may well relate to the learning effect in better estimating portion size when participants were exposed to the use of food models twice during their 24hdr interviews, which were conducted before the second eFFQ administration. Another possible reason is that participants tried to complete the second eFFQ sooner, especially when they attended survey session together with their peers. Based on average completion time recorded at 24hdr interviews, male participants (particularly Asians) completed 24hdr2 quicker than they did in 24hdr1 (25±11 min. in 24hdr2 vs. 30±12 min. in 24hdr1). The same trend happened among female participants but they took a slightly longer time than male participants to complete both 24hdrs (31±12 min. in 24hdr2 vs. 34±13 min. in 24hdr1). This behavior might have also driven participants to complete eFFQ2 quicker without paying as much attention as they did in eFFQ1.

Compared to the Continuing Survey of Intakes by Individuals (CSFII) 1994-1996, 1998 (44), mean calcium intake reported in this study was approximately 200 mg/day higher than that reported by males aged 6-11 years old (984 mg/day) and 12-19 years old (1145 mg/day), as well as females aged 6-11 years old (773 mg/day) and 12-19 years old

(865 mg/day). Higher intake of dairy products among these eFFQ participants (of which many families farm in the valley) might contribute to a higher intake of calcium than other youth in the U.S. However, although the mean calcium intake of these multiethnic youth was higher than national average, their calcium intake was still below the Adequate Intakes level (AI) for calcium (1300 mg/day for youth between 9 and 18 years old).

Based on Avg24hdr, the overall mean calcium intake tended to be higher among males (1284 mg/day) than in females (1060 mg/day). This can be attributed to a greater amount of food consumed by the average male youth than female youth. When adjusted for energy intake, there was no significant difference in mean calcium intake between sexes (50±18 mg/100 kcal per day for males vs. 51±20 mg/100 kcal per day for females). Novotny and colleagues reported mean calcium density intake estimated among 167 10- to 18-year-old youth, using two 24hdrs, where males consumed 52±22 mg/100 kcal per day and females consumed 50±18 mg/100 kcal/day (45). Our finding confirms previous studies that reported no significant difference between sexes in calcium intake after adjustment for energy (45, 46).

Based on Avg24hdr collected in this study, there seemed to be a significant age difference ($p<0.05$). Fifteen- to 18-year-old youth reported a higher mean calcium intake in Avg24hdr (1272 mg/day) than 11- to 14-year-old youth (1085 mg/day). This observation on mean calcium intake contrasted with that reported by Jensen (14) and Novotny (45). However, when adjusted for energy intake, the age difference was longer significant. Mean calcium density intake reported by 15- to 18-year-old youth in this

study was 53±19 mg/100 kcal per day vs. 49±19 mg/100 kcal per day reported by 11- to 14-year-old youth ($p>0.05$). This confirms the above findings from Jensen (14) and Novotny (45).

A significant ethnic difference was also observed in this study. Asian youth reported the lowest mean calcium intake in both eFFQs and 24hdrs whereas Hispanic youth consistently reported the highest mean calcium intake on eFFQs. White youth reported the highest mean calcium intake on 24hdrs. When adjusted for energy intake based on 24hdrs, ethnic difference remained statistically significant in which White youth's diet contained the highest mean calcium density (58 ± 19 mg/100 kcal per day), followed by Hispanic youth's (51±21 mg/100 kcal per day) and Asian youth's (42±14 mg/100 kcal per day). This observation was similar to Jensen (14) and Novotny's (45) findings. Ethnic differences in calcium intake are of potential importance because low bone density and osteoporosis also occur in notable proportions of Asians, which is as high as prevalence among Whites (47, 48). One possible reason for a lower calcium intake reported by Asian youth in this study was that the eFFQ food list possibly did not adequately include other important calcium sources in the Asian diet. To name a few significant calcium sources in Asian foods, these may include common soup ingredients (such as bone, lily, and barley), oyster sauce, fish sauce, fermented fish with black beans, and calcium-fortified oriental crackers. However, this lower calcium intake among Asian youth may be better explained by the amount of soda pop consumed by Asian youth. On average, Asian youth in this study consumed soda pop 14 times more frequently (2-6 cans per week) than their Hispanic and White peers (1-3 cans per month for both ethnic

groups). Increased soda consumption has been associated with decreased calcium intake among children (49). Therefore, the much higher soda pop consumption among Asian youth in this study may largely contribute to a lower calcium intake. Asians are also found to have a higher prevalence of lactose intolerance (as high as 90% of Asian but at varying degrees) (8). However, in this study, lactose intolerance did not appear to be a major factor in contributing to this ethnic difference in calcium intake. Of three Asians (6%), one Hispanic (2%) and one White (2%) youth of the entire sample in this study who reported being allergic to lactose, dairy products, or milk, only one Asian specifically reported having lactose intolerance.

Several strengths are evident in our study, some of which were also addressed in the previous evaluation study of the paper version of this FFQ (14). First, this evaluation study builds upon a previously and successfully evaluated FFQ, and shows comparable performance. Furthermore, compared to the evaluation study of the paper FFQ, we have recruited a larger sample of Hispanic participants, and are therefore more confident of the utility of the eFFQ among Hispanic youth. Second, a standardized 24hdr protocol was used, thereby minimizing the effects of interviewer bias. Third, three ethnic/racial groups with approximately equal representation were assessed for calcium intake, and foods that were unique to these three ethnic/racial groups were selected as calcium sources and included on the FFQ, thus 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 subgroups.

Sixth, mean calcium intakes for each of the gender, age, and ethnic/racial groups were similar to other published calcium intake data (14). In addition to the aforementioned general strengths of the study, other strengths of using an electronic version of the FFQ include: 1) color food photographs that helped to clarify the food items, particularly ethnic foods, queried in the eFFQ; 2) photographs of specific portion sizes in a standardized physical setting might help participants better estimate portion sizes when responding to intake frequencies; 3) audio narration throughout the eFFQ helped retain participants' attention and provided encouragement for survey completion; 4) easy administration was positive for both study staff and participants; 5) direct electronic output of all eFFQ responses provided immediate and error-free data collection, consequently substantially decreasing data entry load; and 6) the interactive mode and prompts in the eFFQ made the entire survey session fun and short. All of these features may help to increase both participation and retention in future studies.

Despite these apparent strengths, limitations were also apparent in this study. First, seasonal variation was inevitable since sampling was conducted from fall to spring. Second, there was no option for participants to check or modify their previous answer(s) throughout the entire survey session. Third, all participants in this study were from one geographical area of the U.S., which while being the home to these three ethnic groups, limits generalizability somewhat. However, due to the overall high performance of the eFFQ, we believe that this new tool is useful and generalizable for Asian, Hispanic, and White youth populations in the U.S. for estimating calcium intake because its paper version had been tested in other states.

In summary, a nontraditional but appealing, interactive, computerized, and self-administered dietary assessment tool has been developed to estimate calcium intake among Asian, Hispanic, and White youth. We believe that this eFFQ may also be used to estimate calcium intake among multiethnic youth in larger epidemiologic research studies, as a learning tool in school settings and clinical practice, and to evaluate public health interventions to increase calcium intake.

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CHAPTER 4

SUMMARY AND CONCLUSIONS

The goal of this dissertation was to develop and evaluate a computerized, self-administered, multimedia-assisted eFFQ to estimate calcium intake among 11- to 18-year-old Asian, Hispanic, and White youth. Three studies were conducted to evaluate this new instrument.

STUDY 1: FOOD PHOTO PRODUCTION AND FORMATIVE EVALUATION

Seventy-nine sets of digital color photographs portraying the type, kind, and exact serving size of each food item (single or grouped) listed on the W191 FFQ were produced. Four rounds of formative evaluation, (completion of a mini questionnaire or an oral interview) were conducted among 85 volunteers, ranging from high-school students to university professors, to evaluate each photo's representation and appeal. From an original set of over 230 food photos evaluated in Round 1, a final set of 79 food photos was produced. Compared to the original set, this final set of food photos had clearer representation and greater appeal to multiethnic groups and the research investigators. These photos were subsequently incorporated into the electronic FFQ (eFFQ).

STUDY 2: ELECTRONIC FOOD FREQUENCY QUESTIONNAIRE EVALUATION STUDY

An eFFQ created on the basis of the W191 FFQ, and containing a list of 79 foods with corresponding food photos produced in Study 1, was tested for four consecutive

weeks among 161 Asian, Hispanic, and White youth living in Northern Utah. Participants completed an eFFQ during Weeks 1 (eFFQ1) and 4 (eFFQ2), and a 24-hour dietary recall (24hdr) during Weeks 2 and 3. The correlation of calcium intake between the first and second eFFQ administration was 0.72 (transformed Pearson's *r*) for the total sample. Subgroup correlations included: male vs. female ($r = 0.59$ vs. $r = 0.81$), 11-14 years vs. 15-18 years ($r = 0.66$ vs. $r = 0.82$), and Asian vs. Hispanic vs. White ($r = 0.73$ vs. $r = 0.76$ vs. $r = 0.61$). The correlation of calcium intake between eFFQ2 and mean of two 24hdrs was 0.56 (deattenuated, transformed Pearson's *r*) for the total sample. Correlations were also significant for males ($r = 0.50$), females ($r = 0.57$), young (11-14 years, $r = 0.56$), old (15-18 years, $r = 0.59$), Asians ($r = 0.63$), Hispanics ($r = 0.55$) and Whites ($r = 0.57$). Results indicated that the eFFQ performed well and was comparable to its parent paper version, the W191 FFQ, which was previously evaluated by Jensen and colleagues (1). Mean calcium intakes and trends of subgroup differences between the eFFQ and W191 FFQ were very similar. We recruited a larger sample of Hispanic participants for evaluation of the eFFQ than the W191 FFQ, and were therefore more confident of the utility of the eFFQ among Hispanic youth.

STUDY 3: ELECTRONIC FOOD FREQUENCY QUESTIONNAIRE SUMMATIVE EVALUATION

An eFFQ Summative Evaluation Questionnaire (SEQ) was created and administered to participants in the eFFQ Evaluation Study at the end of the final session. Youth evaluated the eFFQ computer program, overall design, audio-visual quality, ease of use, program speed, and interaction. The final set of food photos used in the eFFQ

was summatively evaluated, and participants were asked to provide suggestions for future improvement of the eFFQ. Youth were also queried as to their likes and dislikes of the evaluation study. Seventy-five percent of the participants considered the eFFQ very easy to use; 91% participants could understand everything the narrator said; and at least 96% participants considered the eFFQ gender-appropriate, very or somewhat enjoyable, very or somewhat interactive, and that the eFFQ had an excellent or good sound quality. Of all eFFQ features, participants best liked the food photos (23%), its ease of use (21%), and the positive impact and enjoyment that resulted from answering the eFFQ (18%). Participants least liked the narration (30%), answering format (25%), and the way the instructions and explanations were given (14%). Areas most often suggested for future changes included narration and instructions.

CONCLUSIONS

It is exciting to conclude that we now have a new, self-administered, interactive, fun, and enjoyable dietary assessment tool, practically reliable and accurate to specifically estimate calcium intake among Asian, Hispanic, and White youth living in the U.S. The eFFQ represents a milestone for a new generation of dietary assessment tools that are culturally-, gender-, and age-specific. For future investigation, the following are a few recommendations: 1) allocate enough time and funds to conduct a formative evaluation of the eFFQ before testing it against 24hdrs, if possible, recruit representative focus groups; 2) collect 24hdrs as equally on each day of a week as possible, including Sundays, to better reflect weekday and weekend diets; 3) consult professional food photographers about what alternative substitutes could be used for taking quality food

photos; 4) evaluate the eFFQ in larger geographical areas; and 5) update the eFFQ food list by referring to 24hdrs collected among representative samples, e.g., those collected in this study, to develop an improved version of the eFFQ.

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APPENDICES

Appendix A. Food Picture Evaluation Form

Please tell us about your...

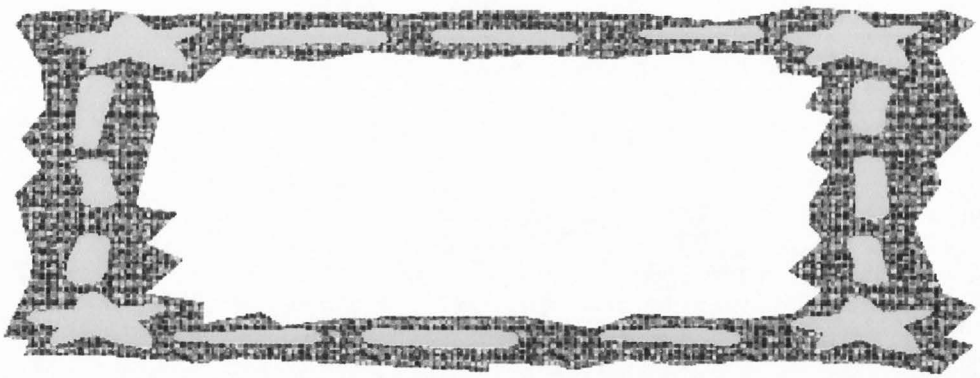
Age = ___ *years*

Gender = *M* *F*

Ethnicity = _____

PICTURE CODE: _____

What food is this? Write your guess of the food name below.



2

Does it look like the food you typically eat? (Check only 1 option)

- ◇ Yes
- ◇ Almost
- ◇ No

- *If you choose "Almost" or "No", briefly describe it to your group interviewer.*

3

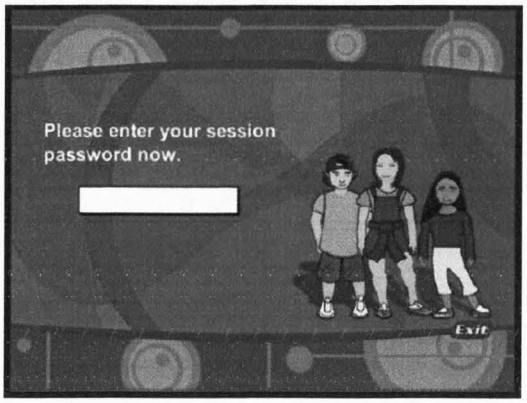
Is this the amount you typically eat at a meal?

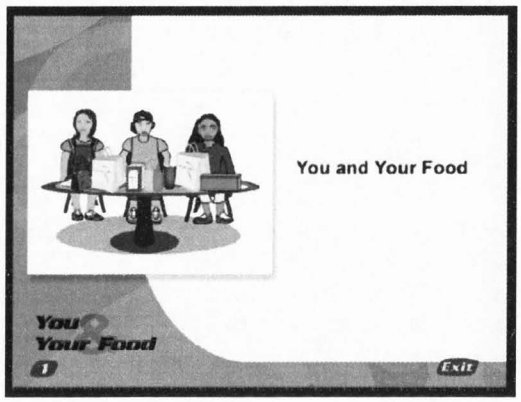
- ◇ Much less
- ◇ Less
- ◇ Same
- ◇ More
- ◇ Much more

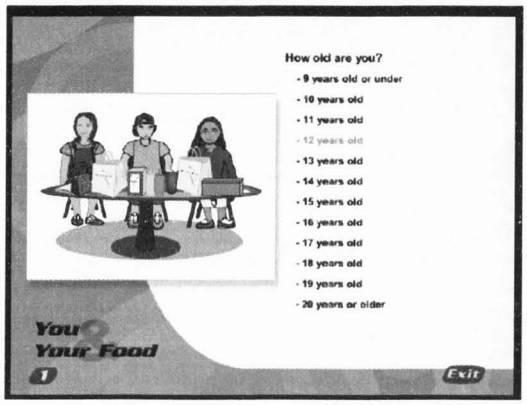
4

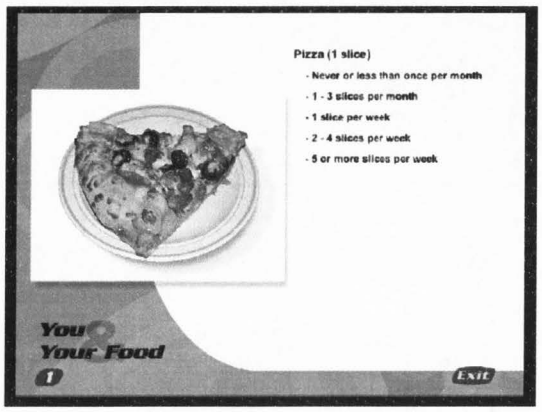
If you were to improve this food photo, how would you do it?

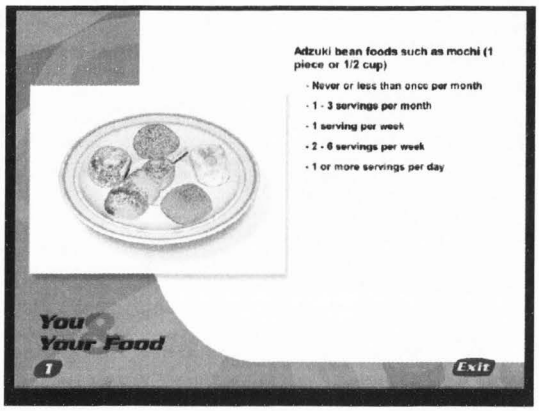
Appendix B. Screen Shot Examples of the Electronic Food Frequency Questionnaire

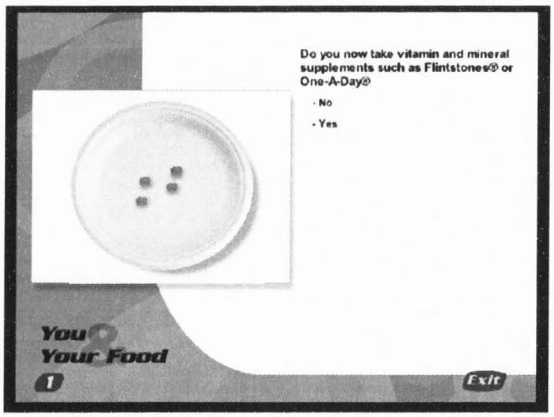

Please enter your session password now.
Exit


You and Your Food
You Your Food
1
Exit


How old are you?
- 9 years old or under
- 10 years old
- 11 years old
- 12 years old
- 13 years old
- 14 years old
- 15 years old
- 16 years old
- 17 years old
- 18 years old
- 19 years old
- 20 years or older
You Your Food
1
Exit


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
You Your Food
1
Exit


Adzuki bean foods such as mochi (1 piece or 1/2 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
You Your Food
1
Exit


Do you now take vitamin and mineral supplements such as Flintstones® or One-A-Day®
- No
- Yes
You Your Food
1
Exit

Appendix C. Electronic Food Frequency Questionnaire
Summative Evaluation Result (Part 1-Part 3)

SUMMATIVE EVALUATION: PART 1

A = Asian, H = Hispanic, W = White, M = Male, F = Female, Y = Young (11-14y), O =Old (15-18y)

A

Legend for A (Ethnicity * Gender)

AM, n=23 AF, n=25 HM, n=34 HF, n=30 WM, n=27 WF n=27

B

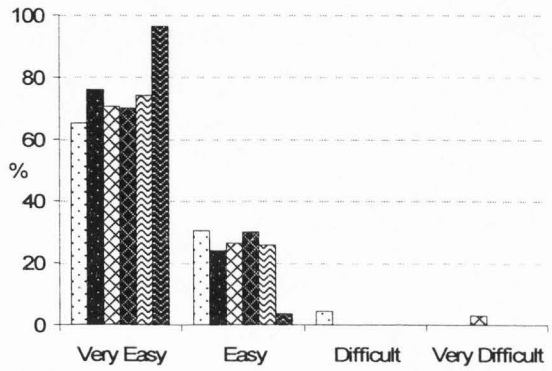
Legend for B (Ethnicity * Age Group)

AY, n=26 AO, n=22 HY, n=33 HO, n=31 WY, n=26 WO n=28

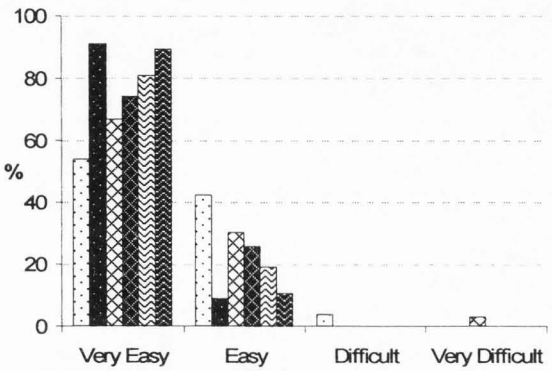
What do you think about the eFFQ?

Q1. Is the eFFQ (Computer survey only) easy to use?

(a)

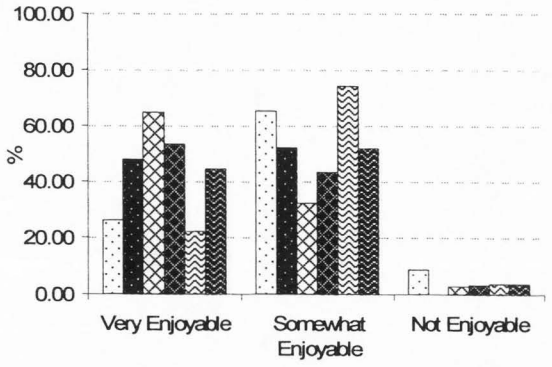


(b)



Q2. Did you enjoy the eFFQ? How would you rate your overall enjoyment?

(c)



(d)

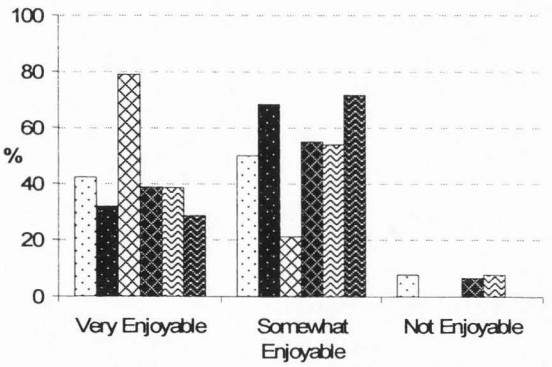
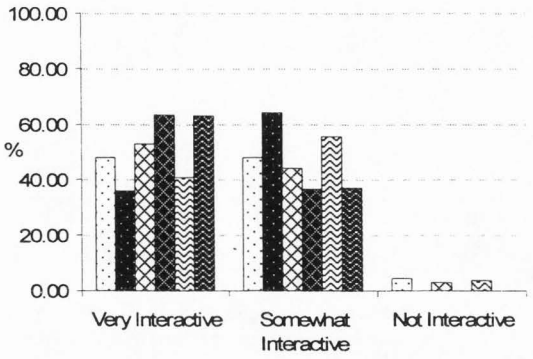


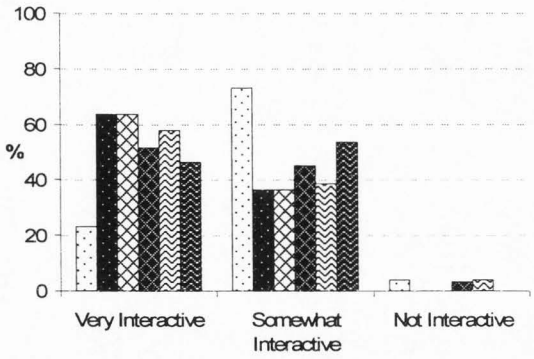
FIGURE C1. Summative Evaluation of the Electronic Food Frequency Questionnaire - Part 1.

Q3. How interactive do you think the eFFQ is?

(e)

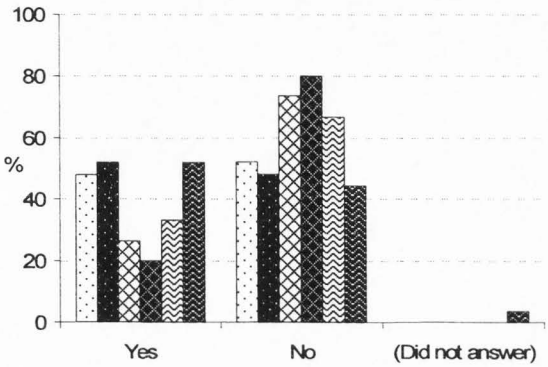


(f)

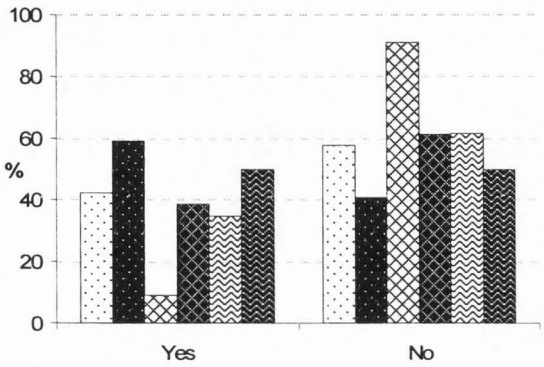


Q4. Did you get bored during the time you answered the eFFQ?

(g)

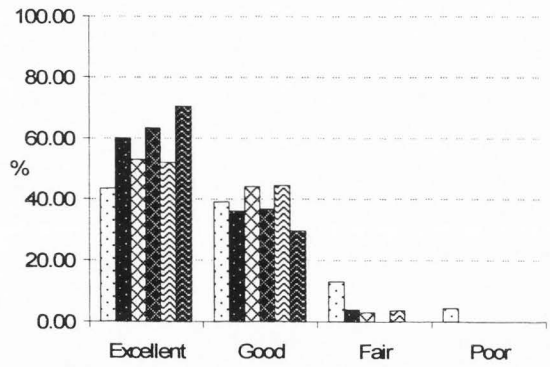


(h)



Q5. How is the overall sound quality of the eFFQ?

(i)



(j)

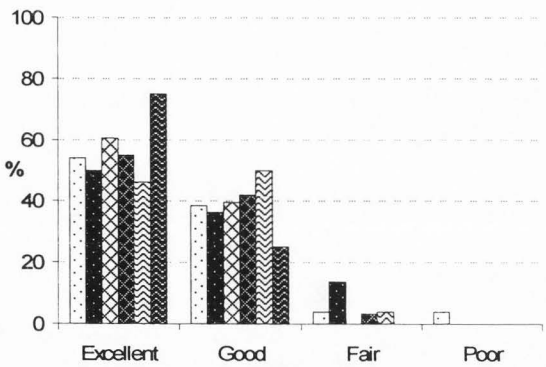
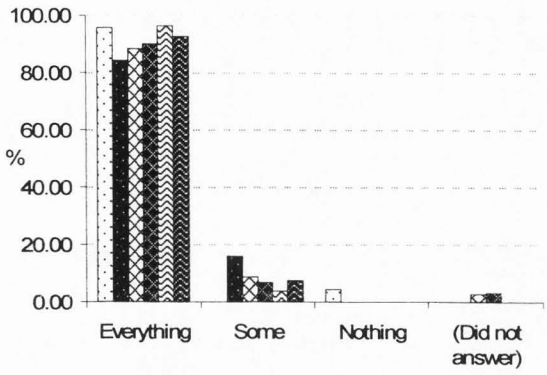


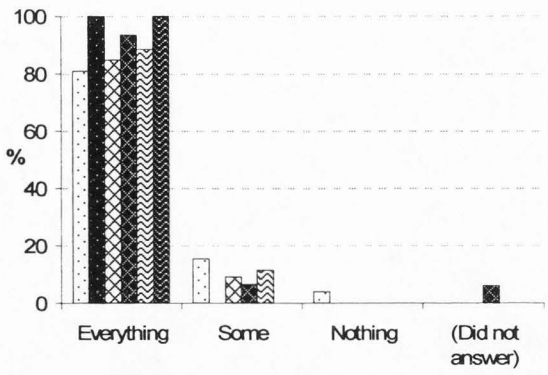
FIGURE C1. Continued

Q6. Could you understand what the narrator was saying during the eFFQ?

(k)

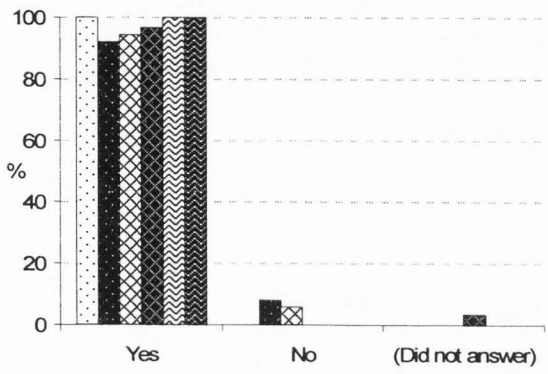


(l)

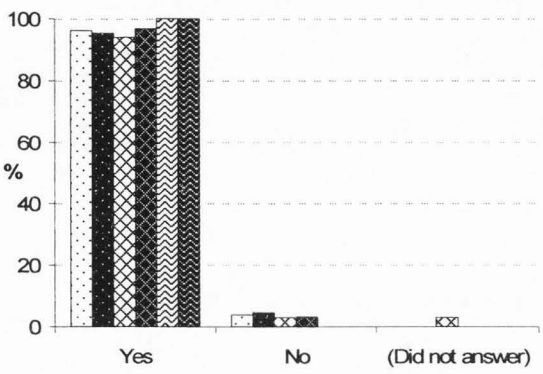


Q7. Do you feel that the eFFQ was appropriate for boys/girls?

(m)

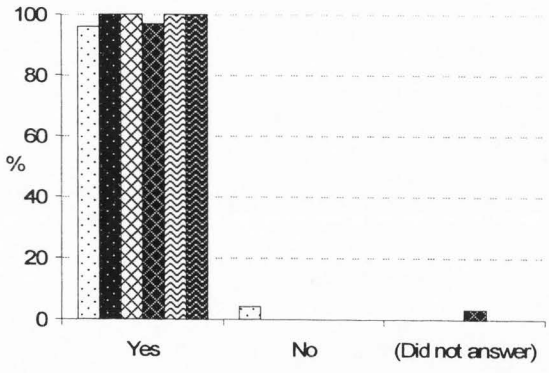


(n)



Q8. Was the font big enough to read in the eFFQ?

(o)



(p)

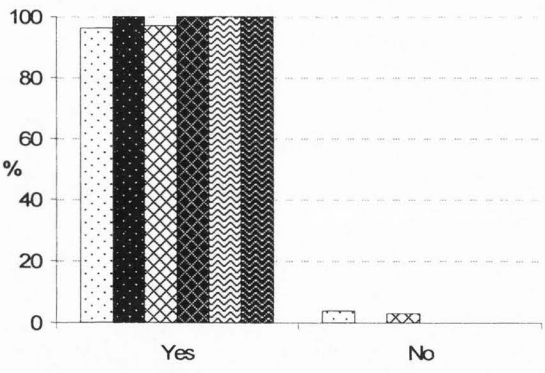


FIGURE C1. Continued

SUMMATIVE EVALUATION: PART 3

A = Asian, H = Hispanic, W = White, M = Male, F = Female, Y = Young (11-14y), O =Old (15-18y)

A

Legend for A (Ethnicity * Gender)

AM, AF, HM, HF, WM, WF

n=23 n=25 n=34 n=30 n=27 n=27

B

Legend for B (Ethnicity * Age Group)

AY, AO, HY, HO, WY, WO

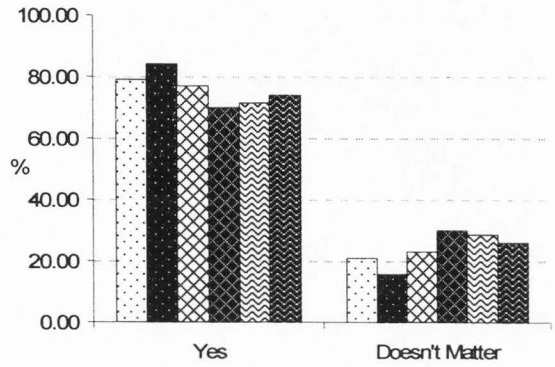
n=26 n=22 n=33 n=31 n=26 n=28

If we made a new version of this eFFQ, please answer the following questions about what you would hope to see.

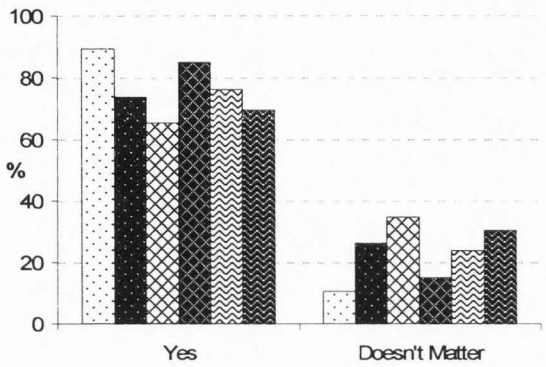
13. Narration (Check all that apply)

i. ___ The instructions should be shorter.

(a)

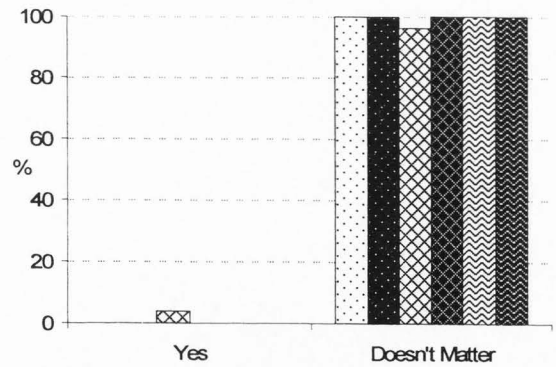


(b)



ii. ___ The instructions should be longer.

(c)



(d)

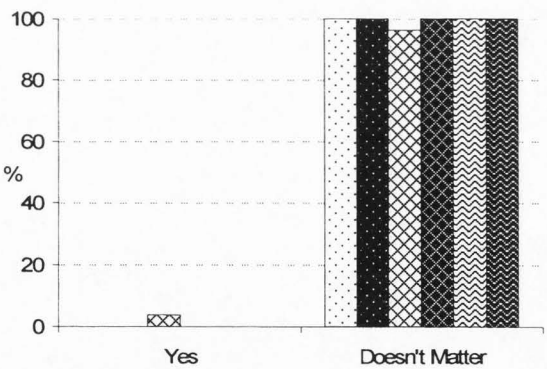
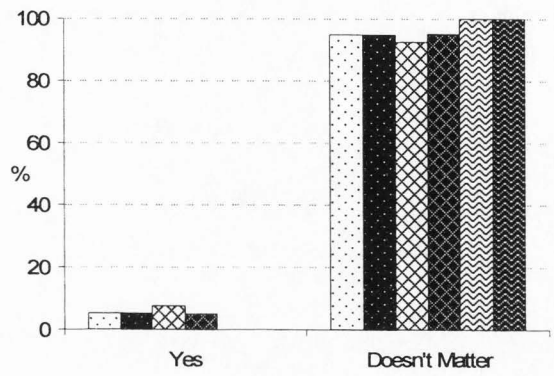


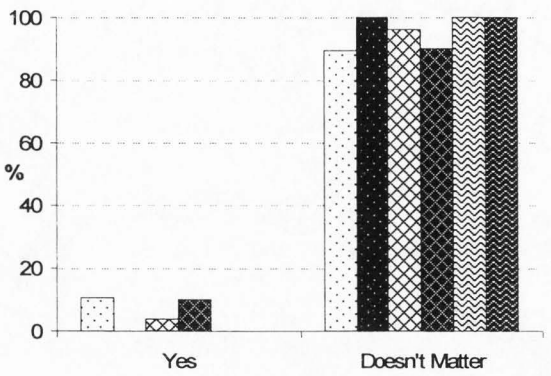
FIGURE C2. Summative Evaluation of the Electronic Food Frequency Questionnaire - Part 3.

iii. ___ The narration should be slower.

(e)

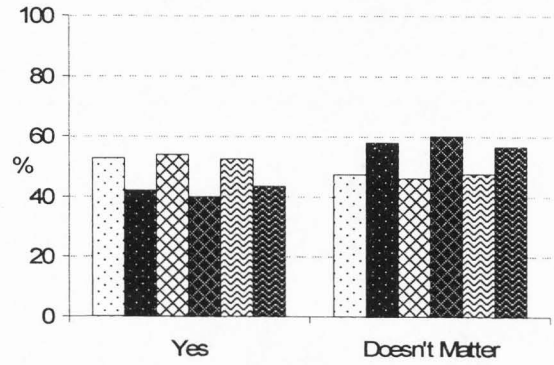


(f)

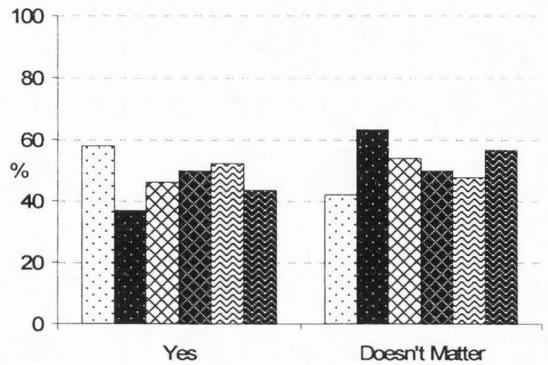


iv. ___ The narration should be faster.

(g)

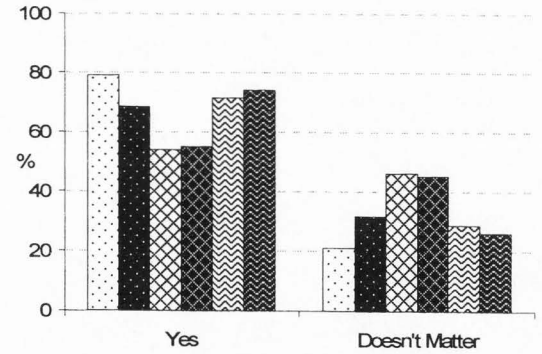


(h)



v. ___ There should be an option to skip the narration.

(i)



(j)

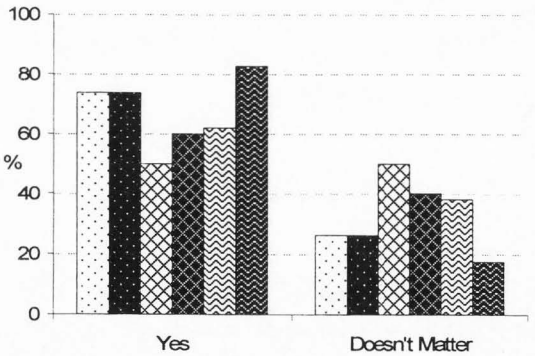
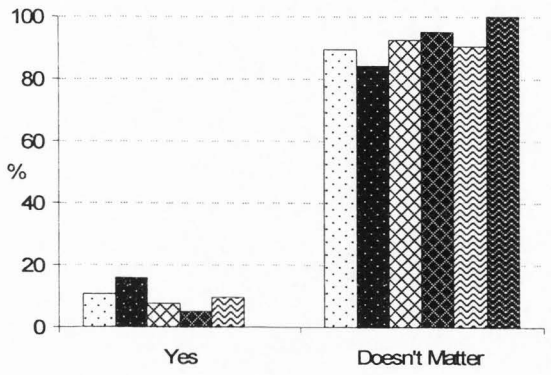


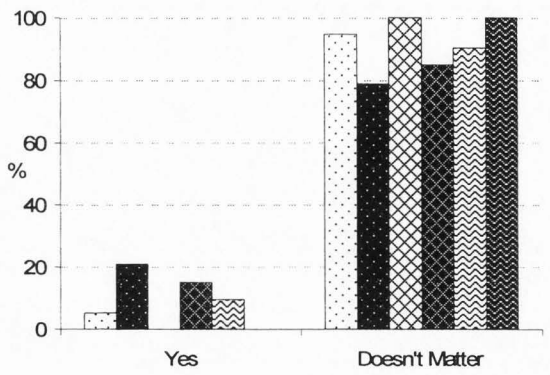
FIGURE C2. Continued.

vi. ___ Use a female voice only.

(k)

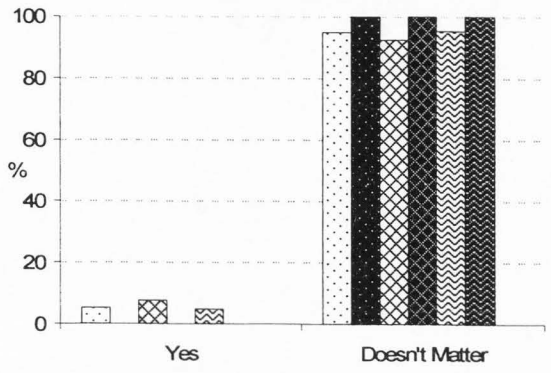


(l)

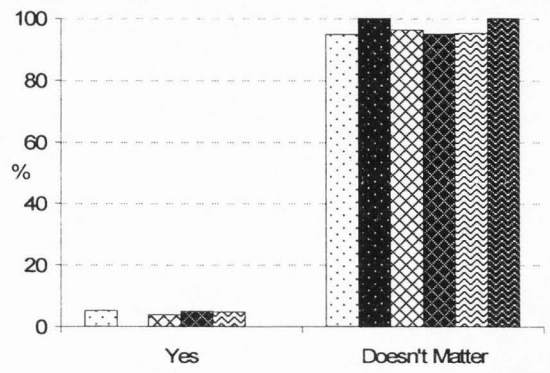


vii. ___ Use a male voice only.

(m)

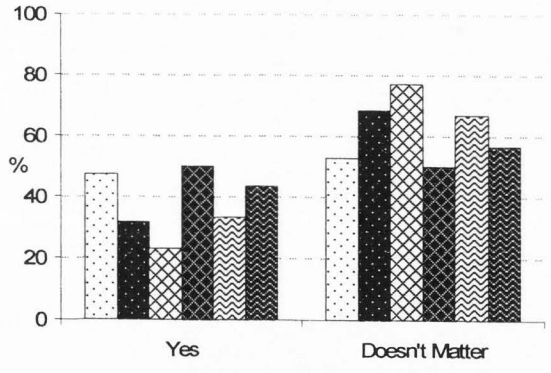


(n)



viii. ___ Use a combination of female and male voices.

(o)



(p)

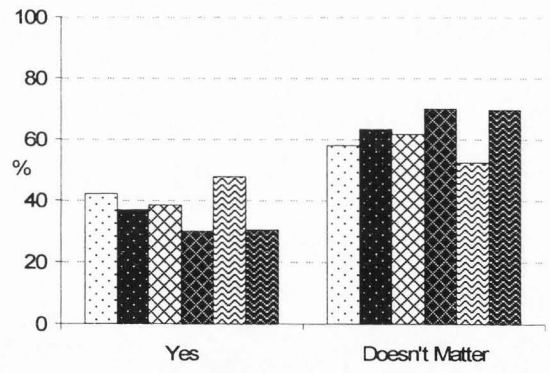
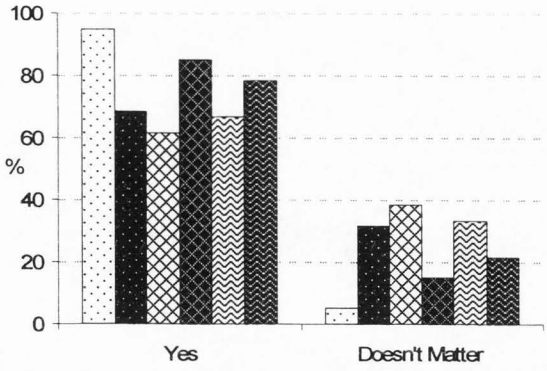


FIGURE C2. Continued.

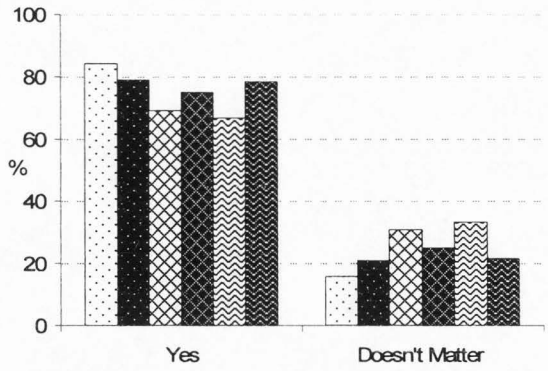
14. Answering (Check all that apply)

i. ___ I would like to be able to move "Backward" and "Forward" to change or check my answer.

(q)

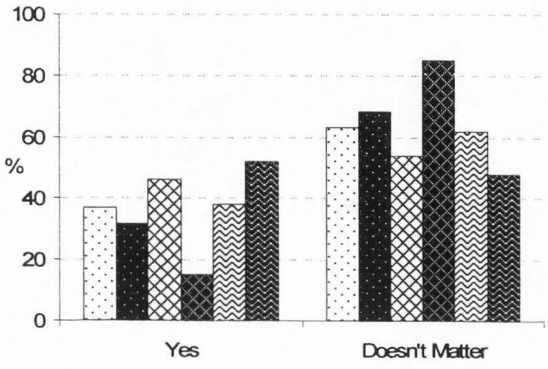


(r)

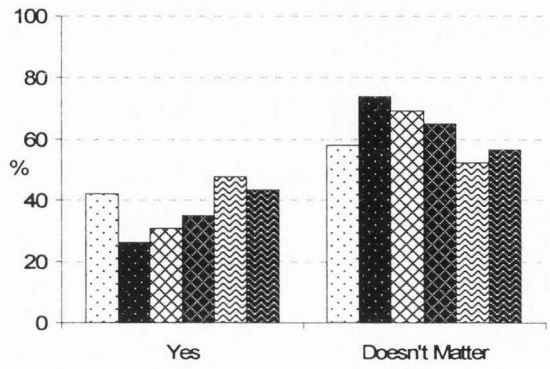


ii. ___ I would like to remove the animation (of a pointer that keeps showing me how to choose a frequency of soda) given at the beginning of the *eFFQ* as part of the survey instruction.

(s)

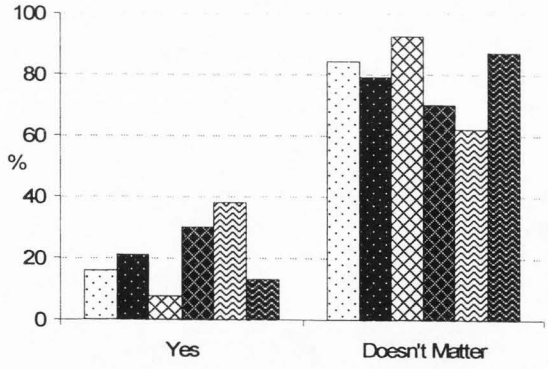


(t)



iii. ___ It would be faster to sort foods that I eat and don't eat first. Then, complete the *eFFQ* only for foods I eat.

(u)



(v)

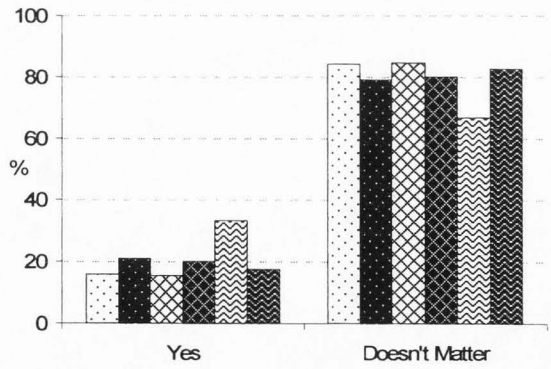
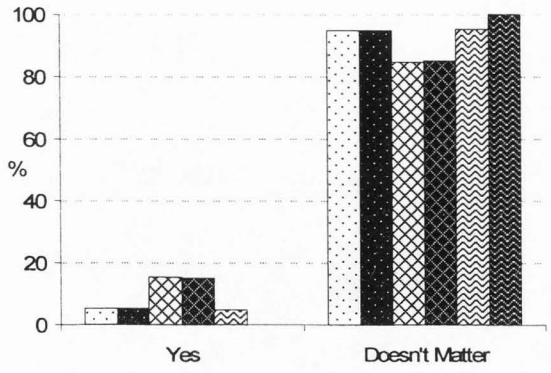


FIGURE C2. Continued.

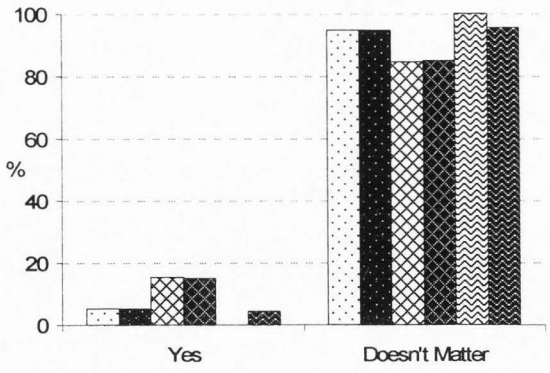
15. Food Pictures (Check all that apply)

i. ___ The food pictures should be bigger.

(w)

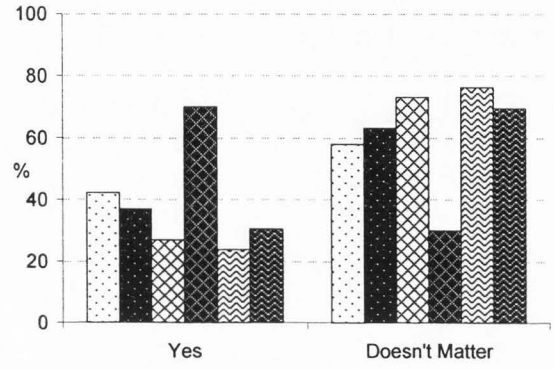


(x)

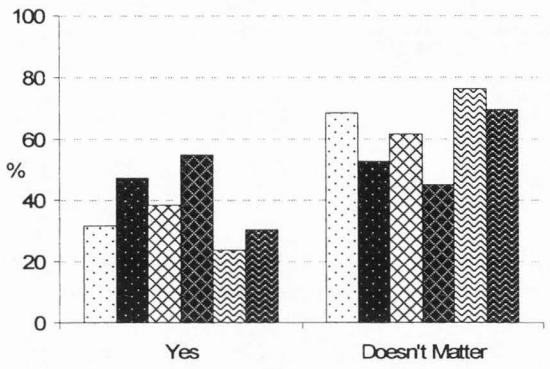


ii. ___ There should be pictures of all of the foods asked in one question. For example, if a question asks about Sushi and Poke, then there should be pictures of both Sushi **and** Poke.

(y)

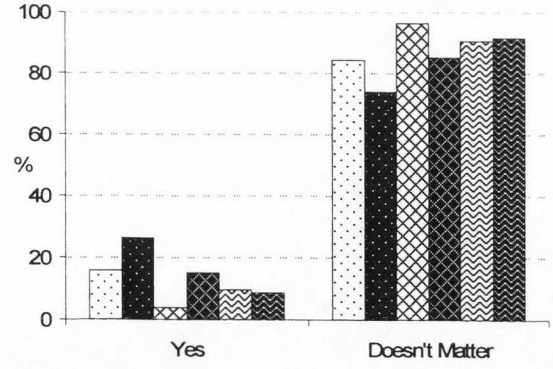


(z)



iii. ___ The foods in the pictures were too boring, and should have had garnishes or decorations added.

(aa)



(ab)

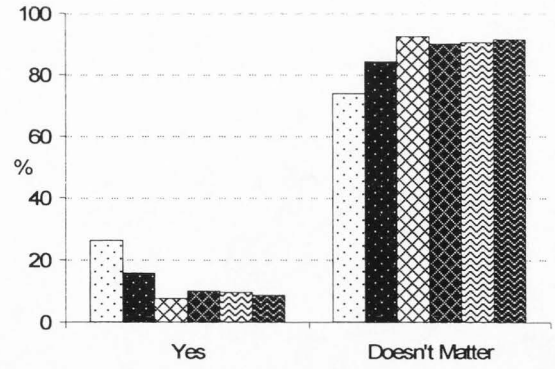
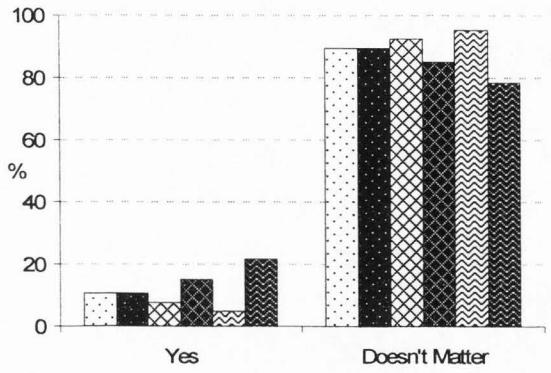


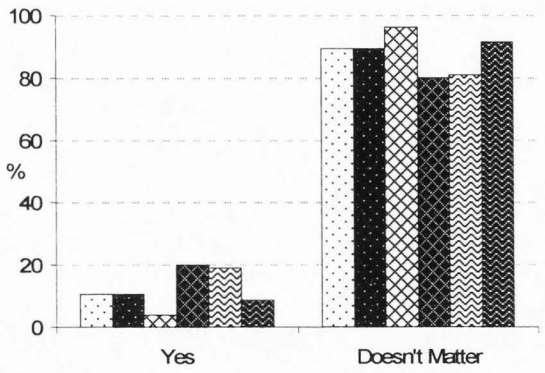
FIGURE C2. Continued.

iv. ___ The dinnerware should have been more colorful.

(ac)

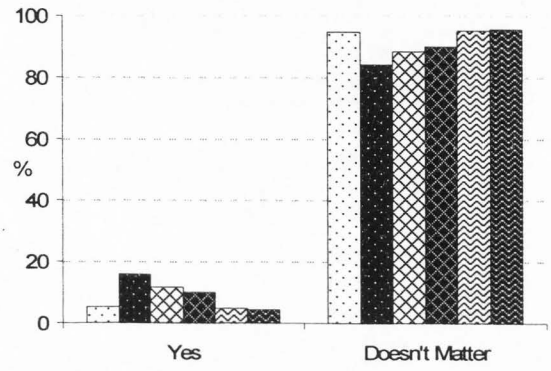


(ad)



v. ___ There should have been another background color for the food pictures, like _____

(ae)



(af)

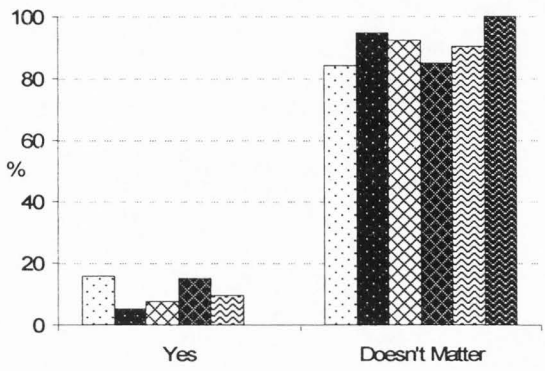


Figure C2. Continued.

Appendix D. 24-Hour Dietary Recall Recording Form with Face Sheet

24-Hour Dietary Recall

Interviewer: _____

Date of Interview: ___ / ___ / 2002

Day of Interview: M T W R F Sa Su

Time Started ___ : ___ AM
PM

Time Ended ___ : ___ AM
PM

ID: _____

Subject's Name: _____

Birth date: ___ / ___ / _____

Age: _____

Sex: M F

Race: A C H

School: _____

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

   USUAL 1 (Q4)
   LESS THAN USUAL 2 (Q2)
   MORE THAN USUAL 3 (Q3)

2. What is the main reason the amount you ate yesterday was LESS than usual?

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

3. 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 REASONS ..... 6 (SPECIFY) _____

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

   YES 1 (Q5)
   NO 2 (Q6)

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

   _____

   _____

   _____

6. 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 (Q7)
   EVERY SO OFTEN 2 (Q7)
   NOT AT ALL 3 (Q9)

7. Looking at card 4, which type 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 + IRON
OR MINERAL(S) .....2 BRAND NAME _____
SINGLE VITAMIN/MINERALS 3
DON'T KNOW 4

[Single vitamins or minerals include small combinations of vitamins or minerals, such as calcium-iron-magnesium, B-complex, etc.]

IS "3" CIRCLED IN Q7?
YES 1 (Q8)
NO 2 (Q9)

8. Looking at Card 5, which of these single vitamins and minerals do you usually take? (CIRCLE ALL THAT APPLY)

VIT. A 01
VIT. B/B-COMPLEX 02
VIT. C 03
VIT. D 04
VIT. 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

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

YES 1
NO 2 (Q11)

10. What food allergies do you have? (CIRCLE ALL THAT APPLY. DO NOT ATE 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 _____

11. 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
NO .....2 (TIME ENDED)

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

	YES	NO
BEER or ALE	1	2
WINE or WINE COOLERS	1	2
LIQUOR (e.g., Whiskey, rum gin, or vodka, or mixed drinks containing liquor)	1	2
OTHER (SPECIFY)	1	2 _____

THANK RESPONDENT

TIME ENDED _____ AM / PM

OFFICE USE ONLY

Did you or the respondent have difficulty with this intake interview?

YES 1
NO 2

What was the reason for the difficulty?

ID _____ Time Began ____ : ____ AM / PM Date of Interview __/__/2002 Day of Interview _____ Time Ended ____ : ____ AM / PM

Q1 Quick List of Food Items	Q1 Time (always ask) Occasion/Location (if stated)	Q3 Time	Q4 Name of Occ.	Q5a Where did you obtain the (FOOD)?	Q5b Where did you eat the (FOOD)?	Q2 Food/Drink and Additions	Q2a Description of Food/Drink and Ingredient Amount	Q2b How much of this (FOOD) did you actually eat/drink?
		A P						
		A P						
		A P						
		A P						
		A P						
		A P						
		A P						
		A P						
		A P						
		A P						

Appendix E. Electronic Food Frequency Questionnaire Evaluation Form

ID _____

Date ____/____/_____

PARTICIPANT *eFFQ* EVALUATION

The following information will be kept confidential but it is necessary for our records.

Your Name: _____

Your Age: ____ **M**ale ___ **F**emale ___

Your Ethnicity: ☐ Asian ☐ Caucasian/White ☐ Hispanic

What do you think about the *eFFQ*?

1. Is the *eFFQ* (computer survey only) easy to use?
   - ___ Very easy to use
   - ___ Easy to use
   - ___ Difficult to use
   - ___ Very difficult to use

2. Did you enjoy the *eFFQ*? How would you rate your overall enjoyment?
   - ___ Very enjoyable
   - ___ Somewhat enjoyable
   - ___ Not enjoyable

3. How interactive do you think the *eFFQ* is?
   - ___ Very interactive
   - ___ Somewhat interactive
   - ___ Not interactive

4. Did you get bored during the time you answered the *eFFQ*? ☐ Yes ☐ No

5. How is the overall sound quality of the *eFFQ*?
   - ___ Excellent
   - ___ Good
   - ___ Fair
   - ___ Poor

6. Could you understand what the narrator was saying during the *eFFQ*?
   ___ I could understand everything the narrator was saying during the *eFFQ*.
   ___ I could sometimes understand what the narrator was saying during the *eFFQ*.
   ___ I could not understand anything the narrator was saying during the *eFFQ*.

6a. If you could not understand everything the narrator was saying, why?

7. For **BOYS only**: Do you feel that the *eFFQ* was appropriate for boys? ☐Yes ☐ No
   For **GIRLS only**: Do you feel that the *eFFQ* was appropriate for girls? ☐Yes ☐ No

8. Was the font big enough to read in the *eFFQ*?
   ___ Yes
   ___ No

9. What did you like the **best** about the *eFFQ*?

10. What did you like the **least** about the *eFFQ*?

11. What things would you like to see changed in the *eFFQ*?

12. Please view the food photos on the computer screen. Only evaluate the foods you know and skip the foods you don't know. As you scroll through the photos, circle the photo number if:

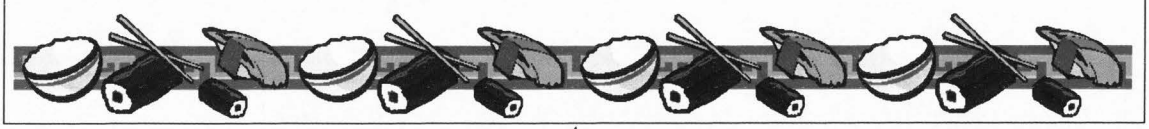
- You think it is a bad photo, or
- You know this food but you could not recognize it from the photo

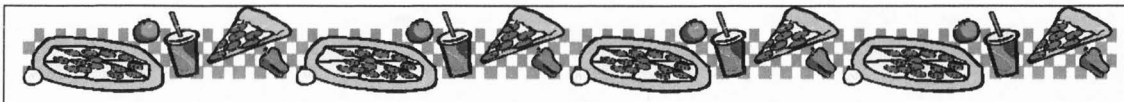
Please write your comments on page 4.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78		

12. (Continued)

Picture Number	Comments





If we made a new version of this eFFQ, please answer the following questions about what you would hope to see.

13. Narration (Check all that apply)

___ The instructions should be shorter.
___ The instructions should be longer.
___ The narration should be slower.
___ The narration should be faster.
___ There should be an option to skip the narration.
___ Use a female voice only.
___ Use a male voice only.
___ Use a combination of female and male voices.

14. Answering (Check all that apply)

___ I would like to be able to move "Backward" and "Forward" to change or check my answer.
___ I would like to remove the animation (of a pointer that keeps showing me how to choose a frequency of soda) given at the beginning of the *eFFQ* as part of the survey instruction.
___ It would be faster to sort foods that I eat and don't eat first. Then, complete the *eFFQ* only for foods I eat.

15. Food Pictures (Check all that apply)

___ The food pictures should be bigger.
___ There should be pictures of all of the foods asked in one question. For example, if a question asks about Sushi and Poke, then there should be pictures of both Sushi **and** Poke.
___ The foods in the pictures were too boring, and should have had garnishes or decorations added.
___ The dinnerware should have been more colorful.
___ There should have been another background color for the food pictures, like _____

_____

16. How do you rate the YES Project?

Areas	Excellent	Good	Fair	Poor	Comments
1. Recruitment method (flyer, radio, and personal contact)					
2. Enrollment package					
3. Flexibility in scheduling appointments with you					
4. Survey locations at USU					
5. Direction signs used					
6. Overall *eFFQ* (computer survey) administration					
7. Overall 24-hour dietary recall interviews					
8. Overall YES Team's professionalism in surveying you					
9. Overall YES Team's friendliness					
10. Appointment punctuality					
11. Appointment reminder (phone call or email)					
12. Snack selection					
13. Participant's ID card design					
14. YES Team member's ID card design					

Thank You Again!!!

Funded by the United States Department of Agriculture

CURRICULUM VITAE

Siew Sun Wong

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EDUCATION

Utah State University, Logan, UT

Dec 2005 **Ph.D. Nutrition and Food Sciences**
Development and Evaluation of An Electronic Food Frequency Questionnaire for Multiethnic Youth.
GPA: 3.9/4.0
Major Professor: Deborah Gustafson, Ph.D.

- Nutrition Epidemiology
- Advanced Public Health Nutrition
- Community Nutrition
- Advanced Human Nutrition & Metabolism
- Clinical Nutrition
- Sports & Fitness Nutrition
- Nutrition Assessment
- Advanced Biochemistry
- Food Chemistry
- Statistical Design of Experiment
- Linear Regression and Time Series
- Categorical Data Analysis
- SAS and SPSS
- Research Evaluation
- Health Aspects of Aging
- Multicultural Psychology
- Adolescent Psychology
- Human Physiology, Anatomy, & Endocrinology

Dec 1999 **M. S. Nutrition and Food Sciences**
Maternal nutrition and prevalence of cleft lip and/or cleft palate in The Philippines. GPA: 3.8/4.0
Major Professor: Ronald G. Munger, Ph.D., M.P.H.

Sep 1997 International Teaching Assistant Workshop
Completed with the highest score of 395 out of 400 in class

May 1996 **B. S. Nutrition and Food Sciences**
Human nutrition. National Dean's List throughout degree. Cum Laude

Trinity College of London, United Kingdom

Nov 1993 Violin-Performing Licentiate of Trinity College of London (LTCL). Passed with Distinction
LTCL Advanced Music Theory

Associated Board of the Royal School of Music, United Kingdom

Dec 1992 Grade 8 Piano, Violin, and Music Theory. Passed with Distinction

ADMINISTRATIVE EXPERIENCE

Aug 2005 -Present **Director, Utah Expanded Food and Nutrition Education Program (EFNEP)**
Utah State University Extension and Nutrition & Food Sciences Department, Logan, UT

- Provide state leadership to administer EFNEP in Utah.
- Compiled a CSREES Utah State EFNEP Portfolio (2000-2004) for Office of Management and Budget in U.S. congress.
- Partner with Food Stamp Nutrition Education Program personnel to deliver quality nutrition education to clients in Utah.
- Attend national and regional trainings, and train EFNEP staff.
- Review current EFNEP curriculum and develop additional curriculum.

TEACHING EXPERIENCE

Utah State University, Logan, UT

Aug 2005-Present **Assistant Professor**

Spring 2006 ***Biomedical Aspect of Nutrition/Human Diseases Interaction (NFS 6820)***
- A new three-credit elective graduate course.
- Developing and setting up course content in WebCT.

1995-2001 **Instructor**

Fall 2001 ***Advanced Human Nutrition & Biochemistry (NFS 4020)***
- Upper-division course required for all Nutrition, Dietetics and Didactic juniors and seniors.
- Team-taught, instructed independently for 1/3 course time on Metabolic Pathways by using multimedia and WebCT.
- Managed grades (on WebCT), examinations, quizzes, assignments, and review sessions.
- Established and maintained resources on WebCT for course (e.g., grades, sample exams and quizzes, class notes with Power Point Presentations, chapter highlights, and etc.).

Achievement:
- Received department and college above-average teaching evaluation.

Summer 2002 ***Understanding Nutrition (NFS 1020)***
- Introductory course required for all Nutrition, Dietetics and Didactic freshmen, or a general-education course for other majors.
- Team-taught, instructed independently for 1/3 course time on Vitamins and Food Safety by using multimedia and WebCT.
- Managed grades (on WebCT), examinations, quizzes, assignments, and review sessions.

Achievement:
- Established exam rubrics (including online version) for students to focus on specific areas in a chapter. All students appreciated this resource and it helped them to achieve better understanding of the entire course.

1995 - 1996 ***Expanded Food & Nutrition Education Program (EFNEP)***
Cache County Extension Service, UT
- Instructed international females about nutrition and culinary arts via English, Mandarin, Cantonese, and/or Malay languages. Regular home visits included.
- Assessed individual diets and advised participants to provide better nutritional care to themselves and their family.
- Planned program outline, prepared lesson handouts, and organized cooking classes.
- Translated existing teaching material from English to Mandarin for use in teaching non-English-speaking international females.

Achievement:
- Helped more than 20 international females to complete the entire course of EFNEP.

1995 - 1996 **Teaching Assistant**

Nutrition Science & Application (NFS 101)
- Assisted in grading exams, quizzes, and assignments; managed grades for approximately 400 undergraduate students.
- Handled weekly Supplemental-Instruction sessions and pre-exam review sessions for students.

Malaysia & Utah State University, Logan, UT

1993 - Present **Private Music Teacher**
- Teach introductory level of violin, piano, and music theory to children and adults.

RESEARCH EXPERIENCE

Graduate Research Assistant
Utah State University, Logan, UT

1999 - 2005 ***Adequate Calcium Today – Bone Health Project for Adolescents***
- Subcontract from a USDA-funded, multi-centered study of calcium intake among Asian, Caucasian, and Hispanic adolescents in Utah.
- Designed and implemented research protocols, questionnaires, forms, and other materials.
- Trained and supervised a team of 7 undergraduate students. Trained team to use CSFII Multiple-Pass Method in dietary-recall collection, and ESHA Food Processor 7.9 in data entry.
- Conducted and moderated weekly team meetings.

Specialized Tasks:
- Photographed and edited >200 foods in various visual settings. Conducted formative evaluations of digital food photos among adolescent focus groups.

- Coordinated recruitment of 250 participants in Northern Utah, computer and oral survey administration, appointment and survey location scheduling, incentive payment preparation, snack purchase, and data-entry networking.
- Programmed double data entry. Maintained recruitment database and nutrient database.
- Organized storage and filing of data (electronic files and paper questionnaires) and research tools.

1999 - 2003 ***Tribal Elderly Diet & Nutrition Project***
- USDA-funded, multi-tribal nutrition study among Northwestern Portland Area Native American elderly.
- Collected dietary recalls from elderly in Fort-Hall Indian Reservation, Idaho.
- Entered dietary data in ESHA Food Processor and SPSS.

1996 - 1999 ***Philippine Birth Defect Pilot Study for Mothers of Cleft Children***
- NIH-funded pilot case-control study to evaluate the prevalence of cleft lip and/or palate among children and maternal nutrition in The Philippines.
- Assisted in research study design, questionnaire design, data collection and management.
- Fieldwork in Central Philippines (Negros, Cebu, and Davao). Total sample collected = 1850.
- Developed methods to calculate nutrient intake of Filipino diet by using reconstructed nutrient databases, FoodCalc, and ESHA Food Processor.
- Compiled and maintained nutrient databases (over 2,000 foods) specifically for Filipino diets.
- Programmed doubled data entry. Entered data. Analyzed data. Interpreted and presented results.
- Maintained and upgraded computer systems and databases in work place.

Utah Study of Nutrition and Bone Health for Elderly
- NIH-funded, multi-centered longitudinal study of elderly nutrition and bone health.
- Analyzed dietary intake, intake frequencies of individual foods, and common portion sizes, by age and gender, of 2000 elderly participants.
- Compiled and maintained an updated supplement database.

Newsroom and Race Study for Youths
- Assisted in programming double data entry. Entered data collected from 3255 participants.
- Assisted in data analysis.

Cache County Study on Memory in Aging for Elderly
- Analyzed and graphed distribution of sources of more than 20 nutrients from foods.

Spring 1995 **Undergraduate Research Assistant**
- Assisted in analyzing ascorbic acid content of LifeRich® Energy Bar for food labeling.

SKILLS

Language	Speak and write fluently in English, Chinese (Mandarin and Cantonese), and Malay Language	
Computer	**Statistics**	Window SPSS and SAS
	Data Management	SPSS Data Entry Builder, MS Excel, MS Access, Key Entry III, and Lotus 1,2,3
	Nutrient Analysis	ESHA Food Processor & ESHA Port, FoodCalc, Computrition, and Mosby Nutritrac
	Web & Graphics	Web Course Tool, Photoshop, Adobe Illustrator, Gif Animation, FTP
Artistic	Violin, Piano, and Chinese calligraphy	

AWARDS & SCHOLARSHIPS

1999 - 2004	Graduate research grant for Bone Health Project
1999	Women & Gender Research Institute Graduate Research Grant Award
1996 - 1999	Graduate research grant for the Philippine Birth Defect Pilot Study
1995 - 1996	College of Family Life Scholarship
1995 - 1996	LifeRich® Scholarship
1994 - 1996	National Dean's List
1994 - 1996	Dr. Niranjan & Josephine Gandhi Scholarship and College of Agriculture Honor Roll

PROFESSIONAL AFFILIATIONS

Membership	Phi Upsilon Omicron – Kappa Chapter
	Phi Kappa Phi – Utah State University Chapter
	National Golden Key Honor Society
	Experimental Biology
	American Society for International Nutrition
	American Society for Nutritional Sciences
	American Public Health Association
	Utah Public Health Association
	Operation Smile – Student Chapter at Utah State University

PROFESSIONAL TRAINING

Oct-Nov 2005	ERS4, NEERS5, FOCIS, WebCT, Open CourseWare, Macromedia Dreamweaver
Sep 2005	Banner (Chart of Account, Online Requisition, Research Accounting, P-card Processing)
Jun 2002	CSFII and SR-15 Nutrient Databases
May 2000	WebCT
Feb 1998	OSHA Laboratory Safety Training
	OSHA Bloodborne Pathogens Training
Sep 1997	International Teaching Assistant Summer Workshop at Utah State University

PROFESSIONAL PRESENTATIONS & PUBLICATIONS

Presentations

S. S. Wong. Nutrition Update. Utah Family and Consumer Science Agent Annual In-Service Training. Provo, UT. Oct 17-19, 2006.

S. S. Wong & D. R. Gustafson. "Food Picture Creation for Asian, Caucasian, and Hispanic Adolescent Dietary Survey". Accepted for oral presentation at the 5th International Food Data Conference and the 27th National Nutrient Databank Conference, Washington D. C. Jun 2003.

E. Galindo, A. W. Sorenson, P. Pehrsson, J. Hallfrisch, and **S. S. Wong**. "The Novel Use of Native American Food Composition Data by the Shoshone-Bannock Tribes". Accepted for oral presentation at the 5th International Food Data Conference and the 27th National Nutrient Databank Conference, Washington D. C. Jun 2003.

S. S. Wong & D. R. Gustafson. "Food Picture Creation for Asian, Caucasian, and Hispanic Adolescent Dietary Survey". Oral presentation at the 2003 Intermountain Paper and Poster Symposium, UT. Mar 2003.

S. S. Wong, R. G. Munger, and D. G. Hendricks. "Prevalence of Orofacial Cleft Among Filipino Mothers in the Philippines in relation to Functional Vitamin B-6 Deficiency". Oral presentation at the Medical School of the University of Malaya, Kuala Lumpur, Malaysia. Sep 2000; Poster presentation at the 4th International Conference on Dietary Assessment Methods, AZ. Sep 2000.

R. G. Munger, H. Wengreen, **S. S. Wong**, and N. A. West. "Vitamin K Intake and Risk of Osteoporotic Hip Fracture in Utah Women". Presented at the Society for Epidemiology Research Annual Meeting. Jun 2000.

H. Wengreen, R. G. Munger, **S. S. Wong**, and N. A. West. "Comparison of a Picture-Sort Food Frequency Questionnaire to 24-Hour Dietary Recalls in an Elderly Utah Population". Presented at the Society for Epidemiology Research Annual Meeting. Jun 2000.

S. S. Wong, D. G. Hendricks, & R. G. Munger. "Coffee Intake and Anemia Among Filipino Women in the Philippines". Oral presentation at 1999 Utah Academy of Science Spring Conference - Biological Division, Provo, UT. May 1999.

Publications

S. S. Wong. "Development And Evaluation Of An Electronic Food Frequency Questionnaire For Multiethnic Youth". Utah State University Ph.D. Dissertation, 2005.

H. Wengreen, R. G. Munger, **S. S. Wong**, N. A. West, and R. Cutler. "Comparison of a Picture-Sort Food Frequency Questionnaire to 24-Hour Dietary Recalls in an Elderly Utah Population". Public Health Nutrition, 4(5): 961-70. Oct 2001.

S. S. Wong. "Prevalence and Possible Causes of Vitamin B-6 Deficiency Among Women in the Philippines". Utah State University M. S. Thesis. Dec 1999.

Work in Progress

S. S. Wong, D. Gustafson, C. Boushey, J. Gleason. "Evaluation of an Electronic Food Frequency Questionnaire that Estimates Calcium Intakes of Multiethnic Youth". Manuscript in preparation for submission to Journal of American Dietetic Association.

S. S. Wong, D. Gustafson, C. Boushey, J. Gleason. "Production and Evaluation of Food Photos and An Electronic Food Frequency Questionnaire for Multiethnic Youth". Manuscript in preparation for submission to Journal of Nutrition Education and Behavior.

S. S. Wong, P. Scott. "Sources of Calcium and Dietary Calcium Intake of 11-18 years old Multiethnic Youth in Utah". Manuscript in preparation for submission to Journal of Extension.

S. S. Wong, P. Scott. "Dietary and Behavioral Assessments of EFNEP Participants in Utah". Manuscript in preparation for submission to Journal of Extension.

OTHER PROFESSIONAL AND VOLUNTEER SERVICES

2004 - Present	**Teacher**. Children & Adolescent Sunday Bible School at Logan Chinese Baptist Church (LCBC). **Fellowship Leader**. Weekly bible study fellowship at LCBC. **Worship Department Team Leader**. Sunday Services at LCBC.
2001	**Session Leader**. Nutrition and Food Science oral presentation session at the Intermountain Paper and Poster Symposium. Logan UT. Mar 2001.
2000	**Student Reviewer Volunteer**. Utah Public Health Association Annual Meeting.
1997	**Secretary**. USU Nutrition and Food Science Club.
1996 - 1998	**Student Researcher**. Operation Smile International Philippines Mission in Negros, Cebu, and Davao. Spent two weeks each year to collect diet and biochemical data from Filipino mothers of children with or without oral clefts for a Philippine birth defect case-control study.
1996 - 1998	**Vice President & Secretary**. USU Malaysian Student Association.
1990 - 1994	**Free-Lance Professional Violinist**. Malaysian National Symphony Orchestra, Kuala Lumpur City Hall Orchestra, Kuala Lumpur Symphony Charity Orchestra.