DISSERTATION

Development and Evaluation of a Bilingual Interactive Multimedia Computerized Food Recall

Submitted by

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We herby recommend that the dissertation prepared under our supervision by Jamie Marie Zoellner entitled DEVELOPMENT AND EVALUATION OF A BILINGUAL INTERACTIVE MULTIMEDIA COMPUTERIZED FOOD RECALL be accepted as fulfilling in part requirements for the doctorate of philosophy degree.

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ABSTRACT OF DISSERTATION

DEVELOPMENT AND EVALUATION OF A BILINGUAL INTERACTIVE MULTIMEDIA COMPUTERIZED FOOD RECALL

The objective of this research was to use advancements in computer technology to develop and test a bilingual interactive multimedia (IMM) dietary assessment tool. Research supported decisions were used in the development of the recall particularly for determining which foods and portion sizes should be represented. Foods represented in the IMM recall were determined by examining 191 individual 24-hour recalls from Colorado Expanded Food and Nutrition Education Program participants and from the 1982-1984 Hispanics National Health and Nutrition Examination Survey. The US Department of Agriculture's 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) *Quantities Consumed per Eating Occasion* for all individuals age 2 and over was used to help determine which portion sizes should be represented. This program underwent several developmental phases of alpha testing to determine the effectiveness of the introduction, food groupings, graphics, audio, and program flow. Twenty-five peer-reviewers rated characteristics of the program on a 5-point Likert scale. The mean score of each question received high ratings including introduction/directions helpful (M=4.5), meal times understandable (M=4.6), foods easy to identify (M=3.9), portions easy to identify (M=4.5), and computer food recall easy to use (M=4.5). In the final format, the bilingual IMM recall represents a multiple-pass method in which users first report food choices from 167 graphically represented foods. Then, options to choose food variety, cooking techniques and portion sizes are displayed. Lastly, users are provided the opportunity to add and delete foods. A corresponding database generates a nutrient profile for each user comprised of 20 dietary constituents.

After the development and formative evaluation, the IMM recall underwent comparative validity testing against an interview-administered dietary recall. This study was a two-period cross over design study with repeated measures. Subjects were randomly assigned to complete an IMM recall or interview-administered 24-hour recall first. The interview-administered recall was analyzed using the Food Intake Analysis System (FIAS) and the EFNEP Reporting System (ERS). The effect of substituting standardized portion sizes for reported portion sizes was examined. Of 80 adult Coloradoan participants, 71 (91%) were female, 45 (56%) had $\leq 12^{th}$ grade education, 65 (81%) had ≤ $15,000 annual income, and 21(26%) completed the IMM recall in Spanish. Analysis of variance and unadjusted and energy-adjusted correlations were used for analysis. No significant group differences were found for order of administration or demographic characteristics. The only significant method effect found was between the IMM recall and FIAS for vitamin C (P=0.025). The unadjusted correlations between the IMM recalls and interview-administered recalls analyzed using both FIAS and ERS were generally around 0.6. Energy-adjusted correlations consistently decreased relative to unadjusted correlations. Substituting standardized portion sizes resulted in significant differences for six nutrients and caused all correlations to drop.

Overall, the IMM recall was found to be valid for assessing dietary intake by groups of individuals. Using standardized portion sizes compromised the data, and therefore portion sizes should be queried. In light of the exploratory nature of this project and

novel approach at assessing diet, overall statistical and qualitative findings were impressive. This IMM recall has been well received in the peer-review process and attracted the interest of nutrition educators. The results of comparative validity testing and positive reactions received from participants and nutrition educators indicate diet assessment utilizing IMM holds tremendous potential.

The IMM dietary recall can directly link food choice, portion sizes, and cooking methods to generate a nutrient profile. Instant data entry can save staff time and resources and allow more time to be spent on nutrition education instead of dietary analysis. This recall provides potential for stimulating food recall with audio and visual cues and promoting more honest reports of food intake. IMM technology can allow dietary assessment in those underserved populations that are commonly excluded from research studies due to the inability to read and/or write English, including low-literate and multiple ethnic group populations. Furthermore, there is great potential to interface results from an IMM generated nutrient profile with specific nutrition education messages aimed at improving food choice and dietary patterns.

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INTRODUCTION

In the U.S., low literacy rates and an increasing Hispanic population are well documented (Kirsch, Jungebut, Jenkins, & Kolstad, 1993; *U.S. Census Bureau*). However, the specialized needs of this socio-culturally diverse population, including an inability to speak and/or read English, is an exclusion factor for many recent studies attempting to improve upon dietary assessment methods (Conway, Ingwersen, Vinyard, & Moshfegh, 2003; Subar et al., 2003; Subar, Thompson, Kipnis et al., 2001). Providing bilingual and/or non-written alternatives to assess diet complicates data collection and the validation of dietary assessment tools. Furthermore, great expense is involved with providing highly trained staff to participate in the multi-step process of dietary assessment including data collection, manual coding and computerized data entry of food items.

Dietary intake information is traditionally collected using self-administered written methods or collected verbally via a trained interviewer. Common methods of dietary assessment tools include 24-hour recalls, food frequency questionnaires, and diet histories. Each method has unique disadvantages related to administration, reliability and validity (Thompson & Subar, 2001). Despite many drawbacks, self-reported dietary intakes are routinely used to determine the intake of populations and/or individuals.

Recent advances in technology have allowed for the use of computers in health and nutrition education. Although computerized interactive multimedia (IMM) for nutrition education has been developed and tested extensively, there is relatively little research in utilizing IMM for overall dietary assessment (Brug, Campbell, & van Assema, 1999; Brug, Oenema, & Campbell, 2003; Gould & Anderson, 2000; Jantz, Anderson, & Gould, 2002; Oenema, Brug, & Lechner, 2001). Computerized IMM has the potential of addressing many of the short-comings of current dietary assessment methods including the opportunity to: conduct personalized, in-depth interviews without the costs involved in providing one-on-one interviewers; obtain standardized collection with appropriate levels of probing; provide instant data entry; give immediate feedback to respondents; ensure that all responses are complete; and provide visual and aural cues to stimulate recall (Kohlmeier, Mendez, McDuffe, & Miller, 1997). Additionally, IMM is appropriate for use in multiple ethnic groups and populations with low literacy (Gould & Anderson, 2000; Jantz et al., 2002).

There are a variety of limitations with existing IMM dietary assessment tools. First, most are not comprehensive and only look at specific aspects of food intake, for example fat or fruit and vegetable intake (Block et al., 2000; Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999). Many require some level of literacy and keyboarding skills, and none of the existing IMM dietary assessment tools are bilingual (Baranowski et al., 2002; Block et al., 2000; Campbell et al., 1999; Kohlmeier et al., 1997; Sumner, Keller, & Diamond, 1996). Finally, little research has been conducted testing the reliability and validity of these instruments.

Colorado State University previously developed and performed validity tested for a bilingual IMM dietary recall to assess fat and fiber intake at breakfast in a low-income, low-literate, Hispanic and Caucasian adult population (Lowe, 2001). Promising statistical results combined with overwhelming positive feedback received from participants and nutrition educators revealed further development and testing of an IMM dietary recall was a worthwhile investigation.

The overall goal of this project was to develop and evaluate an IMM dietary recall program useful for assessing diet within the target population, including low-income, low-literate, Hispanic and Caucasian adults. The bilingual IMM program was expanded to assess a comprehensive nutrient profile, including 20 dietary constituents, at lunch, supper and snacks. The following chapters present a review of the literature, followed by two manuscripts. The purpose of the manuscript in chapter two was to describe the formative evaluation process and progressive steps used in the development of the IMM dietary recall. The purpose of the manuscript in chapter three was to explain the validity testing of the IMM dietary recall as compared to an interview-administered dietary recall. Chapter four then details qualitative findings and recommendations for future development of the IMM recall. Finally, an overall discussion as well as conclusions, future research and application are presented in chapters five and six.

CHAPTER 1: Literature Review

Introduction

Assessing dietary intake is an extremely difficult task. There are a variety of factors that may influence food reporting including: honesty, memory, comprehension level, ability to estimate portion size, social acceptability of food choices, and reading level of assessment tool. There has been an exhaustive amount of research done on perfecting valid and reliable dietary assessment tools. Many of the current dietary assessment tools are designed for and evaluated with white adults (Teufel, 1997). The generalizablity of these tools for use with low-income, low-literate, minority populations is limited. Although, low literacy rates and an increasing Hispanic population in the U.S. are well documented, the specialized needs of this socio-culturally diverse population lead to their exclusion in recent research aimed at improving dietary assessment (Kirsch et al., 1993; *U.S. Census Bureau*). Inability to speak and/or read English is an exclusion factor for many recent studies attempting to improve upon dietary assessment methods (Conway et al., 2003; Subar et al., 2003; Subar, Thompson, Kipnis et al., 2001).

In dealing with self-reported data, validity and reliability are major issues. Although there is general agreement that a ceiling exists on the ability to accurately measure self-reported behaviors there is a continuing need to address the limitations of existing self-reported dietary measurement tools in both the general population and population sub-groups (Subar, Thompson, & Kipnis, 2001; Willett, 1998). The use of interactive multimedia (IMM) appears to be a logical and feasible option for improving the assessment of diet in multiple ethnic groups and populations with low literacy.

Low Literate, low income, minority populations

The problems associated with assessing dietary intake are significantly complicated when dealing with low-income, low-literate, minority populations. The specialized needs regarding dietary assessment of this huge segment of the population have consistently been overlooked. Only in recent years, with the increasing diversity of the U.S., has the needs of this audience received increased attention.

Despite a technologically advanced society, illiteracy continues to be a major problem in the U.S. Basic literacy tasks such as filling out a medical history form or recording the foods eaten for a day may be very difficult for some individuals. In fact, the National Adult Literacy Survey (NALS), conducted by the US government found that almost half of adults in the US read at the two lowest levels of proficiency. Twenty-one percent of adult Americans (40-44 million) are functionally illiterate, and read at or below a 5th grade level. An additional 25% (50 million) are marginally illiterate (Kirsch et al., 1993). Literacy proficiency scores conducted in Colorado are close to the national average with 45% of the population at the 2 lowest levels of proficiency, 13.1% are functionally illiterate and 31.9% are marginally illiterate (Lane, 1997). Health and literacy research reveals that a very broad gap exists between the average patient's reading comprehension level and the ability level required to read most health related materials.

Adults with low literacy can be found among all races and at all socioeconomic levels. However, economic, social and cultural factors contribute to higher rates of illiteracy in some population subgroups. There is an apparent literacy gap that occurs along racial lines. The NALS reveals that non-whites, including Hispanics, receive less education than Whites. Even with identical years of schooling, literary rates are not equitable (Kirsch et al., 1993).

Hispanics comprise the nation's largest minority group. The latest 2002 Census Bureau Report indicated 13.3% of the U.S. population was Hispanic. According to the 2000 United States Census Bureau report, 17.2% of Colorado's total population was Hispanic or Latino, this included Hispanic, Puerto Rican, Cuban and other Hispanic or Latino origins. This was up from 12.9% in the 1990 Census Bureau report and exceeded the 2000 national average (*U.S. Census Bureau*).

Impact of literacy on health

Although there have been a number of studies examining the relationship between literacy and a specific diagnosis, there are no known studies that have directly measured the overall impact literacy has on health in the U.S (Kirsch et al., 1993). However, a great deal can be learned from international research exploring the connection between literacy and health. Through studies sponsored by the International Adult Literacy Survey, and a project cosponsored by the Ontario Public Health Association and Frontier College, it is quite clear that low-literacy levels have a major negative impact on health (Perrin, 1990; *Second Report of the International Adult Literacy Survey (IALS): Literacy Skills for the Knowledge of Society*, 1997). Analyses indicate that the lowest educational levels and the poorest health coexist in the same region. People with limited literacy are more likely than others to take part in a wide range of unhealthy lifestyle practices and are less likely to be aware of the importance of health lifestyle practices. Literacy directly influences the ability of people to access health care and make effective use of health information. Not only does literacy adversely affect individuals, it is more costly to society and the health care system.

Results from the National Adult Literacy Survey conducted in 1993 suggest that low health literacy skills increase annual health care expenditures by $73 billion overall. The major source of higher health care expenditures for persons with low health literacy skills is longer hospital stays, ineffective use of prescriptions, and misunderstandings about treatment plans with financial consequences. Given the number of people who have low literacy skills in the United States, it is possible to realize the enormous impact literacy has on health in the U.S.

The National Survey of America's Families published in 2000, reports findings on indicators of well-being by race and ethnicity (Staveteig & Wigton, 2000). All persons of Hispanic origin were grouped by ethnicity into the Hispanic category and non-Hispanics were grouped by racial category. The low-income rate for Hispanics was 61%, this is significantly more than all other races, including 26% of whites, 29% of Asians, 49% of blacks, and 54% of Native Americans. Across all income levels 40.8% of Hispanics experienced food hardship, which is nearly double the 22.8% of all race/ethnicities experiencing food hardship. When asked whether their current health status was excellent, very good, good, fair or poor, Hispanic adults were most likely to report being in fair or poor health. Low-income Hispanics were especially likely to report being in fair or poor health. Overall conclusions are that Hispanics are significantly more likely to be low-income, in fair or poor health, and uninsured than Whites or African Americans.

Socioeconomic status and food consumption

Although disease risk factors are more prevalent among lower socioeconomic strata, food consumption studies give a much less consistent picture of how nutrient composition differs among different socioeconomic levels and ethnic lines. The National Health Interview Study reveals consumption of high-fat foods is lowest among Hispanics (Patterson, Harlan, Block, & Kahle, 1995). Similarly, Winkleby and colleagues found that white adults consumed significantly more fat, as measured by percentage of calories from total fat (37.7 vs 33.3%) and saturated fat (13.7% vs 11.8%), and consumed significantly less dietary carbohydrate (45.5% vs 49.7%) and fiber (17.1 g vs 26.0 g) than Hispanic adults (Winkleby, Albright, Howard-Pitney, Lin, & Fortmann, 1994). Contrary to these findings, the US Department of Agriculture's Continuing Survey of Food Intake by Individuals found that the total fat, saturated fat, and fiber sources do not differ notably between Hispanic and white or black respondents (Thompson, Sowers, Frongillo, & Parpia, 1992). Results from the Women's Health Trial Feasibility Study in Minority Populations also found no difference across race/ethnic groups in total fat intake, however there were many significant differences between race/ethnic groups in sources of fat (Kristal, Shattuck, & Patterson, 1999). Yet another study by Pareo-Tubbeh and colleagues found that Hispanics tend to eat a diet higher in fat (Pareo-Tubbeh et al., 1999). Fat is only one nutrient variable typifying the conflicting dietary data between whites and Hispanics. Other measures of nutrient adequacy and excesses between whites and Hispanics are also disputed in the literature. One of many potential explanations for the conflicting information on nutrient intake within these studies is the assortment of methods used to collect dietary intake information.

Dietary Assessment

It has long been recognized that dietary intake impacts disease. Epidemiological data on diet and disease has been used to describe the health status of populations for many decades. Dietary assessments provide the backbone for public health initiatives and nutrition education programs. However, there is a lot of debate in the literature regarding a true "gold" standard for dietary assessment. Although multiple day food records/recalls are generally thought of to be the gold standard and are used to validate and standardize other assessment methods, there is strong evidence that self-reported dietary instruments, including recalls/records underestimate intake. Studies using unbiased biomarkers, including doubly labeled water for measuring energy intake and urinary nitrogen for measuring protein intake, reveal that reports using food records or recalls are biased in their reporting accuracy, normally towards underreporting (Hill & Davies, 2001; Kaczkowski, Jones, Feng, & Bayley, 2000; Trabulsi & Schoeller, 2001). This suggests that when multiple-day records/recalls are used to calibrate other instruments, including food frequency questionnaires (FFQ), measurement error is introduced to these instruments as well (Kipnis et al., 2001).

The use of self-reported dietary assessment for nutritional epidemiology and dietary surveillance has received heightened attention in recent years with the Observing Protein and Energy Nutrition (OPEN) Study. The purpose of the OPEN Study was to assess dietary measurement error using two self-reported dietary instruments, including the FFQ and 24-hour dietary recall, and two unbiased biomarkers including double labeled water and urinary nitrogen. Men and women were found to be underreporters for both energy and protein on both the 24-hour dietary recalls and FFQs. When compared to biomarkers, men underreported energy expenditure by 12-14% on 24-hour dietary recalls and 31-36% on FFQs. Men underreported protein by 11-12% on 24-hour dietary recalls and 30-34% on FFQs. Women underreported energy expenditure by 16-20% on 24-hour dietary recalls and 34-38% on FFQs and protein intake was underreported by 11-15% on 24-hour dietary recalls and 27-32% on FFQs. Subar, Kipnis and colleagues raise many questions related to the use of self-reported dietary assessment in nutrition epidemiology, specifically the validity of using of 24-hour recalls to calibrate FFQs and adjust findings for measurement error (Kipnis et al., 2003; Subar et al., 2003).

Despite the many drawbacks, self-reported dietary intakes are routinely used to determine the intake of populations and/or individuals. There are many different tools used to assess dietary intake and careful planning must be involved in choosing the correct tool. Numerous characteristic of the audience must be considered including gender, age, income level, reading and comprehension level, ethnicity, and culture. Validity, reliability, and reading level of tool must be considered and appropriately matched with the target audience. Dietary assessment methods include food records, 24-hour recalls, FFQs, picture sorts, diet histories, electronic methods and IMM.

Excluding IMM, validity and reliability of each method has been studied extensively. However, implementation of these tool can vary greatly. Consequently, a great deal of caution must be executed when comparing dietary analysis results between studies. A few variations to consider include use of different validation reference instruments and databases for nutrient analysis, varying number of days and sample sizes, distinctly specific population groups, and adjustments for measurement error and energy intake. It is important to recognize that research findings with one assessment tool typically cannot be used to support findings or explain limitations when a different assessment tool is used. For example, even though research suggests that little additional information is gained by asking portion sizes on a FFQ, this cannot be extrapolated to assume that little additional information is gained by asking portion sizes with a different assessment tool.

Dietary record

With a food or dietary record, the participant is asked to record the foods, beverages, and amounts of each consumed over a period of days. Typically three to four consecutive days of records are used. In theory, recording of the food is done at the time of the eating occasion. Participants must be trained to adequately report foods, amounts, preparation methods, recipes for food mixture, and portion sizes. This method is subject to selection bias because literacy and motivation are required to obtain accurate information. Keeping records over many days result in significant increases in incomplete records. Recording foods when they are eaten may affect both the types and quantities of food eaten. Therefore, the task of recording intake can alter the dietary behavior the tool is intended to evaluate. On the contrary, recording foods as they are eaten results in less exclusion of foods eaten and oftentimes foods and amounts are described more fully. Coding the dietary records can be burdensome and time consuming for staff. As mentioned earlier, food records are often regarded as the "gold standard" to which other dietary assessments are compared (Thompson & Subar, 2001).

24-hour dietary recall

For the 24-hour diet recall method, participants report all the foods and beverages consumed in the preceding 24 hours or in the previous day. The 24-hour recall is conducted using pencil and paper, personal interview, or a combination of the two. When an interviewer is used, probing for details such as portion sizes and food preparation methods can be very useful in recovering more comprehensive information. However, the interviewer must be well-trained, consistent, knowledgeable about foods available, and familiar with cultural and ethnic foods (Thompson & Subar, 2001).

There are many weaknesses associated with the 24-hour recall. If the pencil and paper method is used, literacy of the respondent is required. Additional staff time is needed if an interviewer is used. Coding and nutrient analysis of foods eaten can also be tedious and time consuming. Most individual's diets vary from day to day, and therefore a single 24-hour recall may not accurately characterize an individual's usual diet. For this reason, the principal use of single 24-hour recall is to describe the average dietary intake of a group. However, as will be described later, many government supported food assistant agencies use a single 24-hour diet recall to describe an individual's diet. A strength of the 24-hour recall is low participant burden. Respondents are generally able to recall most of their dietary intake over a 24-hour period in approximately 20 minutes (Thompson & Subar, 2001).

Group mean nutrient intake estimates using a 24-hour recall have been compared to diet records for the same individuals. Mixed results are generated. Some studies show similar estimates and others show that one method gives substantially higher estimates than the other (Bingham, 1987).

Food frequency questionnaires

Food frequency questionnaires (FFQ) have participants record their usual consumption frequency of foods for a specific period. Sometimes portion size data is collected. However, little information besides frequency is obtained. Grouping of foods in a food frequency questionnaire can be cognitively complex for some participants. There has been debate related to the validity of FFQs to estimate a population's diet. FFQ are more often used to rank or group study subjects for the purpose of assessing the association between disease risk and nutrient intake as opposed to estimating absolute intake (Subar et al., 2003).

The major limitation of the food frequency questionnaire is that many details of dietary intake are not measured. Inaccuracies arise from incomplete listing of all possible foods, errors in frequency estimation, and omission or errors in estimation of usual serving sizes. The strength of FFQ is that they are designed to assess usual intake, and recent changes in dietary intake can be measured. Some FFQ questionnaires are scannable which reduces data entry costs and allows for measurement in large populations (Thompson & Subar, 2001).

FFQ have been compared to multiple food records over a period of time. The nutrient correlations between these methods are in the range of 0.4 to 0.7. FFQ with a long list of foods tend to yield higher estimates of food and nutrient intake than the 24-hour recall and the food record (Willett, 1998).

Gladys Block and Walter Willett have developed the two most widely used FFQ. The Block instrument relies heavily on national dietary data for the development of the food lists, portion sizes, and nutrient database. Specific question are asked regarding portion sizes and different portion sizes are assigned to women and men. The Willett instrument uses regression methods for food record data and judgment to organize an extensive list of regularly consumed foods containing nutrients pertinent to the prevention of cancer and heart disease. Portion sizes are not specifically asked, but within the frequency question, respondents are asked how often a particular standard portion size is consumed. The Willett FFQ does not assign different portion sizes to men and women; an assumed standard portion size is used across all groups (Subar, Thompson, Kipnis et al., 2001).

In recent years, great efforts have been made to improve FFQs. Intensive effort has been put forth in the development and testing of the National Institutes of Health paper and pencil version of the Diet History Questionnaire (DHQ). The DHQ is a 36-page booklet which queries the frequency of intake for 124 separate food items. The majority of foods are followed by portion size questions, providing a range of three choices. Additional embedded questions inquire about seasonal intake, food type, food preparation, and additions to foods (for foods added to other foods) (Dietary History Questionnaire, 2003).

Subar and colleagues conducted a study in which two rounds of cognitive interviewing were used to improve the National Cancer Institute-Block Health Habits and History Questionnaire. A concurrent think-aloud protocol was used to determine participants' reactions and comprehension to portion sizes, frequency and time frame, embedded questions, and anchoring. The improved questionnaire, the DHQ, resulted in fewer comprehension problems, less frustration, and answers that were more consistent with respondents' answers to follow-up probe questions (Subar et al., 1995). Thompson and researchers have recently published a cognitive-based DHQ validation study

(Thompson et al., 2002). The objective of that study was to test the accuracy of alternative approaches in question-design issues including grouping of foods, different forms of food, additions to foods, and units of food. The authors concluded that the cognitive theory and testing can be used to restructure questions and improve the accuracy of FFQ reporting.

Additional research with the DHQ includes development of an appropriate food list, establishment of a nutrient database, preparation of analysis software, validity testing, and response rate testing (Subar et al., 2000; Subar, Thompson, & Kipnis, 2001; Subar, Thompson, Kipnis et al., 2001; Thompson et al., 2002). In a validation study, four telephone 24-hour recalls were used as a criterion measure to compare the DHQ, Block FFQ, and Willett FFQ. Results indicate that the DHQ and the Block FFQ are better at estimating absolute intake, but after energy adjustment all three, including the Willett FFQ, are comparable for purposes of assessing diet-disease risk. For 26 nutrients, correlations and attenuation was best overall for the DHQ. Subar and colleagues state that comprehension and ease of administration of dietary assessment methods can be improved through cognitive interviewing of respondents (Subar et al., 1995). The DHQ methodology is an excellent example of the rigorous effort necessary to address the limitations and errors of existing dietary measurement tools.

Picture-sort food frequency questionnaire

Picture sort methods have also been used to assess nutrient intake. Picture sort methods have been designed to mimic written FFQ. Colored illustrations of foods and beverages along with the name appear on a card. The participant is asked to sort the picture on the basis of frequency of consumption over a period of time. An optional element is for an interviewer to ask about usual portion sizes of foods. Many of the strengths and weaknesses of a FFQ persist with the picture sort method with a few exceptions. Literacy demands are minimized with the picture sort method. The picture sort method also may improve the respondents liking for the dietary assessment. On the other hand data collection and processing is complicated.

A commonly used food frequency questionnaire developed by the National Cancer Institute (NCI) was transformed into a picture-sort format. Kumanyika and colleagues then performed a study with 96 elderly men and women ages 66-100 years to compare one administration of the picture-sort method questionnaire to six 24-hour recall interviews (Kumanyika, Tell, Fried, Martel, & Chinchilli, 1996). Crude Pearson correlations ranged from .34 for protein to .64 for saturated fat. Crude Pearson correlations for macronutrients, cholesterol, and fiber were approximately .5 or greater except for protein, percentage of energy from protein, and percent of energy from fat.

Yaroch and colleagues examined the validity and reliability of a modified picture-sort FFQ administered to 22 low-income, overweight, African-American adolescent girls (Yaroch et al., 2000). The FFQ was administered, followed by three 24-hour recalls and then the FFQ was administered again. All assessments occurred within a two-week period. The picture-sort FFQ was shown to be valid. Pearson correlation coefficients for the energy-adjusted nutrients from the second FFQ and the recalls ranging from .32 for protein to .87 for saturated fat, with most values significantly exceeding 0.50. However, the FFQ showed low reliability between test and retest, with most unadjusted values ranging from 0.28 to 0.36.

Diet history

A dietary history can include a variety of elements in which participants are asked to report about their past diet. This may include a detailed interview, a food frequency list, and/or a diet record. A weakness of this method is that participants are asked to make many judgments about the usual foods and amounts eaten. Additionally this method requires a substantial amount of time from a trained interviewer and nutrient analysis can be difficult to manage. The major strength of the diet history is the assessment of usual meal patterns and details of food intake, such as food preparation methods and portion sizes (Thompson & Subar, 2001).

Electronic methods

Electronic methods, including microcassette tape recorders and cameras, have been used to assess dietary intake in attempts to minimize burden and literacy demands of respondents. The use of tape-recorded food intake has been used to assess children's dietary intake in which children self-report via tape recorders documenting dietary intake immediately upon consumption (Lindquist, Cummings, & Goran, 2000). This method was compared to an interview guided recall technique, parent monitoring, and parent's written documentation of the child's intake. The analyses revealed poor validity of the tape recorder method for estimating energy intake among children. Conversely, using a similar study design, VanHorn and colleagues found that children's tape-recorded dietary intake records correlated well with parent's reports ($r \geq .80$, except calories $r = .68$) (Van Horn et al., 1990).

A study by Kaczhowski and colleagues used a combination of a microcassette tape recorder and 35-mm camera, referred to as multimedia diet record (MMDR), to record all foods and beverages consumed for four days (Kaczkowski et al., 2000). This dietary information was compared to a two-point doubly-labeled water method used over 13 days. Mean reported energy intake using the MMDR (1744 $\pm$ 476 kcal/d) were significantly lower ($p < 0.01$) than energy intake determined using doubly-labeled water (2477 + 736 kcal/d). Even using this novel electronic method of collecting dietary information, only 76.0 $\pm$ 22.9% of energy intake was reported.

Computerized nutrient analysis

Computer software to analyze food intake has become very popular over the past decade. There are a wide variety of computerized nutrition analysis programs available. Although a comprehensive list of nutrition software is not available, the Food and Nutrition Information Center (FNIC) of the USDA maintains the largest listing of about 200 food and nutrition software programs. Methods used to collect dietary information vary between programs, but generally the name of the food item is entered into the program. Then a list of matching foods is produced along with a list of portion sizes. The individual is asked to select a food and portion size that is representative of the food eaten. The program then compares nutrient intake to a nutrient standard and a nutrient profile is created (Kolasa & Miller, 1996). The problems with most of these programs are that they require literacy and keyboarding skills. The complexity of these programs can obviously be inappropriate and overwhelming for a low literate audience. Oftentimes dietary information is collected via paper-and-pencil or an interviewer and then subsequently entered into the software analysis by a third party. This can be time consuming and introduce error and bias through interpretation and entering of the reported foods.

Interactive multimedia

Emerging computer technology has resulted in the use of computers to support IMM nutrition education. Development and testing of a variety of IMM nutrition programs have become increasingly popular over recent years. As evident by research conducted by Colorado State University with La Cocina Saludable, there are many advantages of using IMM nutrition education programs. Gould and Anderson evaluated two bilingual IMM modules including "Make It Healthy" (MIH) and "Make a Change" (MAC) (Gould & Anderson, 2000). Ninety-five participants received information from these two IMM modules. The IMM module was completed in Spanish by 13% of participants, 64.6% had annual incomes of less than $10,000 per year, and 86.7% has less than or equal to $20,000 annual income. Significant knowledge gains ($p<0.05$) from entry to post-education and from entry to follow-up were observed for the IMM instruction. This indicates that IMM is feasible option for conveying nutrition education to low-income and Spanish-speaking participants. After the IMM modules were completed, respondents completed a survey. Greater than 85% of respondents marked the highest level which indicated they thought the touch screen was easy to use, they liked using the touch screen, the pictures made sense, and the program was easy to use.

Although computerized IMM for nutrition education has been developed and tested quite extensively, there is relatively little research in using IMM for dietary assessment. Ideally, literacy and keyboarding skills should be eliminated to meet the needs low literate audiences. This can be accomplished with a touch screen computer, which relies entirely on the use of audio and graphics to identify food items.

There are many limitations with the existing IMM dietary assessment tools. First, most are not comprehensive and only look at specific aspects of food intake, for example fat or fruit and vegetable intake. The second limitation is that many require some level of literacy and keyboarding skills. The third limitation is that none of the existing IMM dietary assessment tools are bilingual. Finally, little research has been conducted testing the reliability and validity of these instruments.

An interactive computerized nutrition screening and counseling tool, Little by Little, has been developed and tested at the University of California, Berkley (Block et al., 2000). The program was tested with low-income audiences. The screening portion is a brief dietary intake questionnaire, which only measures the user's intake of fat or of fruits and vegetables. This program is not based on a touch screen computer and it is unclear if graphics are used to represent food items.

Another IMM nutrition education program designed for low-income women enrolled in the Food Stamp program was developed at the University of North Carolina, Chapel Hill (Campbell et al., 1999). The computer-based intervention consisted of a tailored soap opera and interactive "infomercials" that provided individualized feedback based on stage of change. A 16-item food questionnaire was used to determine a dietary fat score. Photographs of a medium serving of each item were represented to visually assist participants with the questions.

Nutrition Discovery is an interactive multimedia food recall questionnaire based on the Block FFQ. This application was designed and developed for Mead Johnson Nutritionals and is used to provide consumer education on the need to take a vitamin or mineral supplement. The program uses storytelling, sound, video, and other aids to personalize the questionnaire and reduce reading ability need to complete traditional FFQ. The user identifies the foods eaten from 100 color food items shown on the screen. The quantity and frequency of foods selected are entered using a mouse. The user is provided with a printout of the USDA Food Guide Pyramid showing the number of servings reported and number recommended for his or her age group. A Great Educational Material (GEM) article featured in the Journal of Nutrition Education in 1996 presents a brief overview along with testing efforts for Nutrition DISCovery (Sumner et al., 1996). However, there is no known research related to validation of the program.

The Food Intake Recording Software System (FIRSSt) is a program designed for use with fourth-grade children (Baranowski et al., 2002). This software program uses IMM to facilitate a child's self-report of diet by simulating a multiple pass 24-hour recall. The child identifies foods within a hierarchically organized system of foods within groups and identifies the portion size within a container to reflect the amount consumed. After each eating event the child is allowed to review and edit food selections. The FIRSSt has undergone validity testing against a school lunch observation and a standard 24-hour recall conducted by a dietitian. One hundred thirty-eight fourth-grade students in two elementary schools participated in the study. Data was analyzed by comparing each individual's set of data and assigning all foods by meal as matches (reported in both records being compared), intrusion (reported in the test measure, but not the validator), or omission (reported in the validator, but not the test measure). FIRSSt attained 46% match, 24% intrusion, and 30% omission rates when compared with school lunch observation, and 59% match, 17% intrusion, and 24% omission rates when compared with a dietitian conducted 24-hour dietary recall. When compared against observation of the previous day's school lunch, FIRSSt attained lower match and high intrusion and omission rates than a dietitian conducted 24 hour recall. The correlation between portion-size estimates was 0.73 for FIRSSt against observation and 0.75 for FIRSSt against 24-hour recall. Considering the children did not receive intensive training on estimating portion size, this level of portion size matching is acceptable.

Although FIRSSt has undergone validity testing, the validity analyses focused on foods matched to the criterion method, as opposed to assessing nutrient profiles. Furthermore, this assessment tool is designed for use in children and is not bilingual. It is unclear how foods and portion sizes were chosen and if foods are represented through clip art or food photography.

Additional research conducted at the University of North Carolina, Chapel Hill by Kohlmeier and colleagues provides the most comprehensive investigation related to the use of multimedia-based dietary assessment tools (Kohlmeier et al., 1997). Kohlmeier's work with computer-assisted self-interviewing (CASI) originally began in Germany in the 1980's with the development of a fully automated tool for obtaining a diet history. The "Americanized" CASI program is designed around a diet history format that uses the structure of a meal to guide the interview process. The presentation of the CASI is lively and colorful. Hundreds of realistic images help the user remember foods, preparation processes, and serving sizes. The simultaneous use of images and sound provides a congruent presentation and allows participation by non-literate and deaf subjects.

At the beginning of the program, questions regarding exactly how often each meal is eaten, when a snack is substituted for a meal, and how consumption on weekends differs from that on weekdays. Respondents then select the categories of foods they usually consume at each meal or snack and then all other categories are bypassed for the remainder of the food category. Frequencies of consumption for each food eaten in the food group are then determined. The quantity of each of the individual foods typically consumed per eating episode is also determined. Users are shown pictures of different portion sizes and given aural cues that identify the sizes of each food item. Information on food preparation is collected and subjects are asked to identify images that most closely represent his or her usual eating behavior.

Kohlmeier states, "The development of multimedia-based dietary assessment tools seems a logical next step in improving dietary assessment methods." This research provides substantial support that CASI can address the short-comings of current dietary assessment methods including the opportunity to: conduct personalized, in-depth interviews without the costs involved in providing interviews; obtain standardized collection with appropriate levels of probing; provide instant data entry; give immediate feedback to respondent; ensure that all responses are complete; provide visual and aural cues to stimulate recall. Additionally, CASI is appropriate for use in multiple ethnic groups and populations with low literacy (Kohlmeier et al., 1997).

Kohlmeier's work provides valuable insight into IMM dietary assessment development. However, there are no known published research addressing the validity and reliability of the dietary history CASI program.

Colorado State University has developed and tested the only known bilingual IMM dietary recall that strictly utilizes graphics and audio to collect dietary information via a touch-screen computer (Lowe, 2001). Audio is available in both English and Spanish.

Literacy skills are greatly minimized and keyboarding skills are eliminated. All food items and portion sizes are represented graphically. Information on food preparation is collected. In a validation study, each subject completed a pencil/paper breakfast recall and an IMM breakfast recall. Subjects were randomized as to which recall method was completed first and randomized to complete either an IMM portion version(IMMp) or IMM no portion version(IMMnp). The type of recall had a significant effect with mean fat (IMM= 21.43; pencil/paper= 7.73 grams) and fiber (IMM= 4.14 grams; pencil/paper= 2.05 grams) values significantly higher ($p<0.0001$) for the IMM recalls than for the pencil/paper recalls.

Three underlying issues may have contributed to this discrepancy. First, the tendency for individuals to underreport food intake on the paper/pencil recalls may have been attributed to having to rely on short-term memory in order to complete the recalls. Literature has shown that, on average, individuals tend to underreport food intake on traditional paper/pencil 24-hour recalls by approximately 20% (Hill & Davies, 2001; Kroke et al., 1999). The results of this study support the literature. Secondly, the large discrepancy may have been due to more accurate reporting of food items eaten with the IMM recall due to prompting, via audio and visual cues. The IMM recall may have also promoted more honest reports of food intake because food choices were disclosed privately without any feedback from a staff member.

This study indicates further development and testing of an IMM instrument to assess food intake is a worthwhile investigation. However, this work simply examined breakfast intake and only evaluated fat and fiber intake. Development and testing of an

IMM dietary recall that examines additional meal times and additional nutrients is warranted.

Reported portion sizes versus standard portion sizes

Many issues must be considered when attempting to assess portion sizes of food consumed with self-reported dietary intake. It is well known that individuals have a difficult time estimating food quantities. Webb and Yahas examined the ability of 79 WIC participants to estimate food quantities for 10 different foods (Webb & Yuhas, 1988). Only one of the ten foods were estimated between 75% to 124% accurate by more than 50% of the subjects. Similarly, Guthrie examined the ability of 147 adults 18-30 years of age to estimate the portion size of self selected amounts of food (Guthrie, 1984). The ability to estimate portion size was poor, with only 8% to 68% of participants able to estimate items within $\pm$ 25% of actual amount; 0% to 67% overestimated portion size by more than 51%; and 0% to 25% underestimated by more that 51%.

Additionally, the within-person variation in portion sizes has generally been found to be larger than the between-person variation (Hunter et al., 1988). Therefore, a large day-to-day variation in portion size makes reporting a "usual" portion size for a given food difficult. The smaller contribution of between-person variance to total variance in portion size implies that a standard portion size may not introduce a large error in the estimation of nutrient intake.

Due to the difficulties in reporting portion sizes and the large within-person variation of food intake, many researches have studied the impact of replacing reported portion sizes with standard portion sizes. Several investigators have found that little extra information was gained by including individual portion size (Hernandez-Avila, Master, & Hunter, 1998; Tjonneland et al., 1992). Portion sizes have been determined to be of minor importance compared with frequencies of food items. After adjustments for energy intake, Hernandez-Avila and colleagues found mean correlation were 0.54 with portion size data and 0.53 without portion size data (Hernandez-Avila et al., 1998).

Previous research conducted at Colorado State University with an interactive multimedia dietary recall for breakfast examined differences in fat and fiber when reported portion sizes versus standard portion sizes were used. There were no significant differences found in the mean fat and fiber values between the IMM version which queried portion sizes and the version which assumed a standard portion size ($p=0.571$ for fat; $p=0.2264$ for fiber) (Lowe, 2001).

On the contrary, numerous other studies have demonstrated significant impacts of substituting standard portion sizes with reported portion sizes (Clapp, McPherson, Reed, & Hsi, 1991; Cotugna & Fleming, 1998; Welten et al., 2000). A recurrent theme demonstrated in the literature is the tendency for the standard portion sizes to underestimate dietary intake. Standard portion sizes are often based on data from the 1985-86, 1989-91 or 1994-1996 Continuing Survey of Food Intakes by Individuals (CSFII) (Krebs-Smith et al., 1997). The CSFII is the USDA's primary survey for estimating individual food and nutrient intake. CSFII uses multiple nonconsecutive days of food intake using 24-hour recalls collected by a trained interviewer. Sampling methods differ between the different years. The 1994-96 CSFII report provides estimated amounts of 107 foods consumed by users at a single time and estimated amounts of 95 foods consumed by users in a single day (Smicklas-Wright, Mitchell, Mickle, Cook, & Goldman).

Clapp and colleagues found that replacing reported portion sizes with standard portion sizes to measure overall nutrient intake of a group led to different study results (Clapp et al., 1991). Trained interviewers conducted the dietary interview using a 97-item quantified FFQ from 159 black and Hispanic women. The FFQ was designed to measure retinol, carotene, vitamin C, and folacin as associated with cervical dysplasia. Three-dimensional food models, household measurements, circles, rectangles, wedges, beanbags, and glasses were used to assist the women in identifying portion sizes. The data was evaluated using reported portion sizes then reevaluated by substituting standard portion sizes for reported portion sizes. Standard portion sizes were based on information from CSFII obtained from *Foods Commonly Eaten by Individuals: Amount per Day and per Eating Occasion*. There were significant differences ($p<.002$) between the nutrient estimates using reported and standard portion size information for the nutrients evaluated. When measuring the consistency of classification of participants into groups of high, medium, and low nutrient intake, calculation of the rho statistic led to values ranging from 0.55 to 0.71. This indicated some misclassification of study participants when replacing reported portion sizes with standard portion sizes.

A large study conducted at the Cooper Smith Clinic in Dallas, Texas evaluated the following effects regarding portion size: 1) substituting standard portion sizes for reported portion sizes on nutrient intake in the 1994 CSFII 2) substituting standard portion sizes for reported portion sizes in the Aerobics Center Longitudinal Study (ACLS) database and 3) substituting adjusted standard portion sizes for reported portion sizes in the ACLS database (Welten et al., 2000). In the CSFII study, for energy and all other nutrients, the reported portion size provided significantly higher intakes than the standard portion size. Differences ranged from 6% to above 50%. For example reported vs. standard portion sizes in men reveals 2310 kcals $\pm$ 942 vs. 1448 $\pm$ 476 kcals for energy and 88 gms $\pm$ 45 vs. 56 $\pm$ 23 gms for fat. Similar results were produced when standard portion sizes replaced reported portion sizes in the ACLS study. Reported portion sizes consistently revealed a higher intake, with differences ranging from 20% to 50%. Standard portion sizes were then adjusted for energy intake by multiplying the standard portion size of each food with a correction factor. The factor was based on the ratio of the mean energy intake from reported portion size to mean energy intake from standard portion sizes. The discrepancy between measured intakes was largely reduced with the adjusted standard portion. Difference ranged from –0.06% to 13%, the only exception was alcohol, which was above 20%. Results from both the CSFII and ACLS study indicated that standard portion sizes largely underestimates nutrient intake. The use of adjusted standard portions led to a reasonable assessment of the absolute intake at the group level.

Block and researchers have demonstrated that use of respondent-reported portion sizes with the Health Habits and History Questionnaire produced higher correlations than use of investigator-determined standard portion sizes (Block, Woods, Potosky, & Clifford, 1990). Cotugna and Fleming demonstrated that total fruit and vegetable consumption increased by approximately 2.6 servings a day when food models were used to aid participants in estimated portion sizes (6.9 $\pm$ 3.87) versus when portion sizes were assumed (4.3 $\pm$ 2.07) (Cotugna & Fleming, 1998).

Food assistance programs

Although there are many apparent limitations with self-report dietary assessment tools, agencies involved with diet and nutrition often utilize these tools to assess nutritional risk and assist in nutrition education. Government agencies funded by the United States Department of Agriculture (USDA), including the Expanded Food and Nutrition Education Program (EFNEP) and The Special Supplemental Nutrition Program for Women Infant and Children Program (WIC), directly measure dietary intake. The Food Stamp and Nutrition Education Program (FSNEP) is a partnership between the federal, state and county levels of government and with numerous community agencies and private businesses. FSNEP often measures dietary intake, however reporting of nutrient intake on a federal level is not required. Although Head Start and Migrant Education also provide nutrition related resources there is no direct measure of dietary intake.

Expanded Food and Nutrition Program (EFNEP)

EFNEP is a program designed to provide free nutrition education classes to those with limited resources. EFNEP targets low-income youth and low-income families with young children. The program specifically targets those who are eligible for income-based assistance programs such as WIC, Food Stamps, Head Start, and Social Services programs. The goal of EFNEP is to improve the nutritional status of low-income individuals and improve their ability to manage food resources. Informational and educational opportunities are provided to promote the development of new skills and new behaviors aimed at attaining self-sufficiency. Educational format includes a series of lessons, often taught over several months by paraprofessionals and volunteers. Participants gain the practical skills necessary to make positive behavior change by the hands-on, learning-by-doing approach.

EFNEP has a nationwide mandatory reporting system, Evaluation/Reporting System (ERS). Participants enrolled in EFNEP are required to complete a written entry and exit questionnaire that includes demographic information, eating behavior questions and a 24-hour recall of dietary intake. In the state of Colorado, FSNEP also uses the ERS system to collect dietary intake and food behavior information. There is not a nationwide mandatory reporting system for FSNEP.

The Special Supplemental Nutrition Program for Women, Infant and Children (WIC)

WIC is a program designed to provide specific supplemental foods, nutrition education, and social and healthcare referrals to low-income pregnant, breastfeeding, and postpartum women, infants, and children up to age 5 years who are at nutrition risk. The program is based on the principle that many low-income individuals are at risk of poor nutrition and health outcomes because of insufficient nutrition during critical growth and development periods. One standard of eligibility for the WIC program is income below 185% of the poverty level. Another standard of eligibility is that participants must be determined to be at nutrition risk. Nutrition risk is broadly defined as (a) detrimental or abnormal nutritional conditions detectable by biochemical or anthropometric measures (b) other documented nutritionally related medical conditions, (c) dietary deficiencies that impair or endanger health, or (d) conditions that predispose persons to inadequate nutritional patterns or nutritionally related medical conditions. Priority is generally given to anthropometrics, hematologic, and clinical evidence of medically based nutrition risks over dietary-based nutrition risk.

Currently, there is not a nationwide reporting system of dietary intake for WIC clientele. FFQ and 24-hours recalls are currently being used to identify dietary risk. However, the entire nutrition risk assessment is being reexamined. The Committee on Scientific Evaluation of WIC Nutrition Risk Criteria has recommended investment "in the development and validation of practical dietary assessment instruments that can be used across WIC programs for the identification of inappropriate dietary patterns, inadequate dietary intake, and food insecurity, recognizing that adaptations may be needed for culturally diverse populations (*WIC Nutrition Risk Criteria: A scientific assessment*, 1996)." The future of dietary assessment methods for WIC is unclear at this time.

Summary

There are a variety of limitations with current self-report dietary assessment methods. Although use of IMM to improve dietary assessment appears logical, there is relatively little research in this area. Since EFNEP currently has a nationwide mandatory reporting system that requires participants to complete an entry and exit 24-hour dietary recall, the IMM recall should be developed to mimic a 24-hour recall. Understanding food choice of the target population and nutrient analysis requirements will be critical in successfully meeting the needs of EFNEP. The validity of an IMM recall in a population similar to EFENP including low-literate, low-income, Caucasian and Hispanic adults needs to be explored.

CHAPTER 2: Development and Formative Evaluation of a Bilingual Interactive Multimedia Dietary Assessment Tool

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Development and Formative Evaluation of a Bilingual Interactive Multimedia Dietary Assessment Tool

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Abstract

Utilizing advancements in computer technology, a bilingual interactive multimedia (IMM) dietary assessment tool that mimics a 24-hour diet recall was developed. Research supported decisions were used in the development of the recall particularly for determining which foods and portion sizes should be represented. This program underwent several developmental phases of alpha testing to determine the effectiveness of the introduction, food groupings, graphics, audio, and program flow. Twenty-five peer-reviewers rated characteristics of the program on a 5-point Likert scale. The mean score of each question received high ratings including introduction/directions helpful (M=4.5), meal times understandable (M=4.6), foods easy to identify (M=3.9), portions easy to identify (M=4.5), and computer food recall easy to use (M=4.5). In the final format, the bilingual IMM recall represents a multiple-pass method in which users first report food choices from 167 graphically represented foods. Then, options to choose food variety, cooking techniques and portion sizes are displayed. Lastly, users are provided the opportunity to add and delete foods. A corresponding database generates a nutrient profile for each user comprised of 20 dietary constituents. This IMM recall will undergo comparative validation testing against an interview-administered 24-hour recall in a bilingual population. This IMM recall has been well received in the peer-review process and attracted the interest of nutrition educators. This recall provides potential for stimulating food recall with audio and visual cues, promoting more honest reports of food intake, and saving staff time and resources via instant nutrient analysis.

Development and Formative Evaluation of a

Bilingual Interactive Multimedia Dietary Assessment Tool

Introduction/Background:

Dietary intake information is traditionally collected using self-administered written methods or collected verbally via a trained interviewer. Common methods of dietary assessment tools include 24-hour recalls, food frequency questionnaires, and diet histories. Each method has unique disadvantages related to administration, reliability and validity (Thompson & Subar, 2001). Despite many drawbacks, self-reported dietary intakes are routinely used to determine the intake of populations and/or individuals. The problems associated with assessing dietary intake are significantly complicated when dealing with low-income, low-literate, and minority populations. Although low literacy rates and an increasing Hispanic population in the U.S. are well documented, the specialized needs of this socio-culturally diverse population lead to their exclusion in research intended to improve the assessment of diet (Kirsch, Jungebut, Jenkins, & Kolstad, 1993; Subar, et al., 2001; Thompson, et al., 2002; U.S. Census Bureau, 2003). There is a continuing need to improve dietary assessment methods both within a general population and within population subgroups.

Emerging computer technologies have resulted in the use of computers to support interactive multimedia (IMM) nutrition education. Interactive multimedia is a feasible and cost-effective option for conveying nutrition education and evaluating outcome assessments in low-income and Spanish-speaking participants. (Brug, Campbell, & van Assema, 1999; Brug, Oenema, & Campbell, 2003; Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999; Jantz, Anderson, & Gould, 2002; Gould & Anderson, 2000;

Gould & Anderson, 2002). Although computerized IMM for nutrition education has been explored quite extensively, there is relatively little research utilizing IMM for overall dietary assessment.

____________________ has recently utilized advancements in computer technology to develop an innovative approach aimed at improving dietary assessment. This project originated in the year 2000, when a bilingual IMM dietary assessment tool to assess fat and fiber for breakfast was developed and tested within a low-literate, low-income, Hispanic, and Caucasian population (Lowe, 2001). Due to the promising results of this study and the overwhelming positive feedback received from the target audience and nutrition educators, ______________ ____________ has continued to utilize this novel approach to improve the assessment of diet.

The IMM dietary recall has been expanded to assess a comprehensive nutrient profile, including 20 dietary constituents, at lunch, supper, and snacks. In large part, the IMM recall has been designed to meet the data requirement needs of the Expanded Food and Nutrition Education Program (EFNEP). EFNEP is a program funded by the United States Department of Agriculture designed to provide free nutrition education classes to those with limited resources. Participants enrolled in EFNEP are required to complete a written entry and exit questionnaire that includes a 24-hour recall of dietary intake.

The overall goal of this project was to develop and evaluate an IMM dietary recall program useful for assessing diet within the target population including low-income, low-literate, Hispanic, and Caucasian adults. The purpose of this manuscript is to describe the formative evaluation process and progressive steps used in the development of the IMM dietary recall.

Development of a Bilingual Interactive Multimedia Dietary Recall

Great efforts were made to formulate research supported decisions in the development of the recall. Due to an IMM breakfast recall having been previously developed and tested, this research focused on developing the lunch, supper, and snacks portion of the recall. Numbered below are the progressive steps taken during this process.

Step 1: Determining food choices

Food choice of the target audience was determined by examining the 1982-1984 Hispanics Health and Nutrition Examination Survey and 191 individual 24-hour recalls from Colorado EFNEP participants(G Block, Norris, Mandel, & DiSogra, 1995). The EFNEP recalls accounted for seasonality of food choice and was representative of Colorado's EFNEP participant demographics for the 1998-1999 reporting period. Foods reported by greater than 2% of the population in one or both surveys, with a few exceptions, were included in the IMM dietary recall. It has been suggested that close ended questionnaires may yield overestimation of fat intake because subjects are not given the option of reporting low-fat varieties of food choices (Vandenlangenberg et al., 1997). For this reason, modified fat varieties of food items were also illustrated in the IMM recall, even though they were not frequently reported in the HNANES or EFNEP recalls. The resulting IMM dietary recall included 167 food items. Representation of 98% of the food choice for a population should represent the intake of the population, and greatly minimize measurement error through exclusion of food items. Two studies by Block indicate that successful questionnaires include foods representing the top 80% or 90% of the nutrient intake of a population (Block et al., 1986; Block, Hartman, &

Naughton, 1990). Food preparation data were also collected and included: 1) fried with oil 2) fried with lard or 3) fried with butter 4) fried with margarine 5) fried with pan spray or 6) baked, broiled, grilled, boiled, or microwaved.

Step 2: Determining portion sizes

The next step was to determine which portion sizes should be represented in the IMM recall. When only three different portion sizes were used, Guthrie (1984) found a strong tendency to choose the middle size. Therefore, the IMM recall features four portion sizes of each food, which forces participants to differentiate between the two middle sizes.

The US Department of Agriculture's 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) *Quantities Consumed per Eating Occasion* for all individuals age 2 and over was used to help determine which portion sizes should be represented in the IMM recall (Smicklas-Wright, Mitchell, Mickle, Cook, & Goldman). Nutrition professionals, experienced in collecting dietary information, aided in determining appropriate increments in portion sizes based on this CSFII data. Consistent increments were used within food groups, but not always between foods groups.

Step 3: Food photography

All foods and portions featured in the recall were photographed with a Canon Power Shot 5300 Digital Elph camera. Photoshop™ (Version 7.0) was used to format and modify food photographs and to remove identifying food brand information. Food photographs have been shown to be a useful and convenient aid in the estimation of food portion sizes (Robinson, Morritz, McGuiness, & Hackett, 1997). When comparing portion size reports for the same foods using food models and equivalent two-dimensional pictures, some respondents reported differently but no apparent bias in the direction of reporting was evident (Posner et al., 1992). A study by Nelson, Atkinson, and Darbshire (1994) showed that using multiple photographs was more accurate than a single average portion photograph. Based on this information, an individual photograph for each portion size of food was taken. Foods were photographed such that participants would be able to interactively grow and shrink portion sizes.

Step 4: Developing a script/format

The script needed to address the following details 1) food choice, 2) food variety (regular, low-fat, fat-free), 3) portion size, and 4) cooking method. There were numerous challenges to developing a script that inquired about each of these aspects regarding eating behavior. To address the issue of length, seven main menu screens were developed, whereby similar foods were grouped together. There were four to five groups of foods featured on each main menu screen. If the user selected a group of foods, the foods were then featured individually and the user selected the specific food eaten. However, it was unclear how to most effectively order questions regarding food choice, organize the script, and format the program. At this point the formative evaluation process began by seeking the expertise of faculty, staff, and graduate students in the Food Science and Human Nutrition Department at Colorado State University through alpha testing (described in the Formative Evaluation Methods & Results section).

Step 5: Recording sound files

Once the English script was developed, recorded, and reviewed through formative testing, the script was translated into Spanish. There were two Spanish-translators used, one who translated the text into Spanish, and one who recorded the Spanish sound files.

This process allowed double-checking of translations. Recording audio files was an on-going process throughout the development of the IMM recall. Changes were constantly being made to the script as feedback was obtained through alpha testing. All audio was recorded in a professional sound studio and was recorded and edited using Sound Forge™ (Version 4.5).

Step 6: Authoring the Interactive Multimedia Program

A private company was hired to program the IMM recall. The IMM recall was programmed using ToolBook™ (Version 8.1). The recall produced a text-based logfile, which indicated the user's identification number and a list of foods and portion sizes reported.

Step 7: Designing a Nutrient Database

A database was designed to create a nutrient profile for each user based on the selections made during completion of the IMM recall. The database was comprised of 20 nutrients or dietary constituents including total calories, carbohydrates, protein, total fat, saturated fat, cholesterol, fiber, iron, calcium, vitamin A, vitamin C, vitamin B6, folic acid, alcohol and the number of servings from each food group including breads and cereals, fruits, vegetables, dairy, meat, and others. The EFNEP Evaluation/Reporting System (ERS) nutrient database was utilized primarily to identify the nutrient composition of foods included in the recall because it is the mandatory reporting system used by all EFNEP agencies nationwide. Sources of information for the ERS nutrient database included Agriculture Research Service (ARS) nutrient data, USDA Handbook 8 series, manufacture data, and reliable local data or recipes (EFNEP Evaluation/Reporting

Systems User's Guide, 1998). An Access™ database was created to read the text-based logfile and produce a nutrient profile.

Formative Evaluation Methods & Results

Two formal phases of formative evaluations were conducted. Formative evaluation proved to be a critical component to the development of the IMM dietary recall.

Methods Phase I Alpha Testing

To determine an effective format for the recall, three different prototypes were initially developed. A subset of 35 foods was programmed for this phase of testing. The three primary objectives of testing the prototypes included determining 1) whether dietary information should be reported collectively (per day) or individually (per eating occasion) at lunch, supper and snacks, 2) whether specifics about portion variety, portion sizes, and cooking methods were to be queried after each individual food choice or after all food choices for the entire day had been collected, and 3) the effectiveness of the introduction/directions, food grouping, graphics, audio, flow, and delivery.

Nutrition faculty, staff, and graduate students from the Food Science and Human Nutrition Department at ______ were recruited to participate in Phase I of Alpha Testing. During this phase, all participants completed prototype one and either prototype two or three. Participants were asked to enter a sample menu into the recall using the different prototypes. During the prototype testing, an interviewer recorded the participants' comments and difficulties encountered while navigating through the program. The participants completed a questionnaire that included four open-ended questions and six questions on a five-point Likert scale to assess the acceptability and user friendliness of each prototype completed.

Results Phase I Alpha Testing

The goal with Phase I Alpha Testing was to perform sufficient testing of the prototypes so that an appropriate format and reoccurring problems encountered by the participants could be identified and addressed before further development proceeded. Main findings were determined if the questionnaire response appeared consistently (Glaser & Stauss, 1967; Krueger & Casey, 2000). This occurred after testing with only six people (N=6). Subjects included two faculty, two nutrition graduate students, and two staff members.

The script format agreed upon most consistently included reporting dietary information individually (per eating occasion) at lunch, supper and snacks (5 of 6 subjects). For example, participants preferred to respond to the statement "*Touch which of these foods you ate yesterday for lunch,*" as opposed to the statement "*Touch which of these foods you ate yesterday.*" The general agreement was that it was easier and more logical to answer questions about each eating occasion individually as opposed to answering questions regarding food choice across all eating occasions for the entire day. Additionally, participants preferred to report specifics about variety, portion sizes, and cooking methods after all food choices for the entire day had been collected (4 of 6 subjects). The general agreement was that it seemed faster and more efficient to simply select foods first. It was distracting to answer specific questions about variety, portion sizes, and cooking methods after each food choice. The mean score of each 5-point Likert scale question received neutral to high ratings including introduction/directions helpful

(M=4.0), food groupings make sense (M=3.7), program flow (M=3.7), portion sizes helpful (M=4.7), and quality of graphics (M=3.5).

There were two major improvements integrated as a result of this first phase of alpha testing. A navigation tool bar was developed and added to the left side of the screen. The toolbar listed foods that would appear on subsequent main menu screens. This allowed users to anticipate the program flow and order of food item queries. A feature that summarized all food selections made, and provided the participant with the opportunity to add and delete food items was also incorporated at the end of the food recall. There were a variety of other improvements implemented including 1) clarification and condensation of the directions, 2) changes in terminology, 3) improvements in the formatting, clarity, and uniformity of the graphics, 4) addition of text displayed beneath each food item represented, and 5) correction of numerous programming glitches.

Methods Phase II Alpha Testing

The results from Phase I Alpha Testing contributed significantly to the further development of the IMM recall for Phase II of Alpha Testing. After the entire program with all 167 foods had been developed and reviewed several times, the second phase of alpha testing was conducted. Nutrition faculty, staff, graduate students, and work study students were recruited to participate in Phase II of Alpha Testing. They were asked to report the foods they had eaten during the previous day via the IMM recall. Participants documented any difficulties or errors they encountered while completing the IMM recall. Afterwards they were asked to fill out a questionnaire including two open-ended questions and five questions on a five-point Likert scale to assess the acceptability and user friendliness of the program.

Results Phase II Alpha Testing

The goal for Phase II of Alpha Testing was to perform sufficient testing so that emerging themes and reoccurring problems encountered by the participants could be identified and addressed before validation testing with the target audience. This occurred after testing with 25 subjects (N=25).

The mean score of each 5-point Likert scale question received high ratings including introduction/directions helpful (M=4.5), meal times understandable (M=4.6), foods easy to identify (M=3.9), portions easy to identify (M=4.5), and computer food recall easy to use (M=4.5). Although many of the comments and feedback obtained were not reported consistently enough to warrant change, there were five topics that three or greater subjects out of 25 reported including 1) explanation of how long the introduction was going to last, 2) confusion over why breakfast was not included in the IMM recall, 3) need for a final reminder to click the "next" button after completing each screen when the subject was beginning the program, 4) choppy/inconsistent volume, and 5) need for a way to go backwards. Appropriate changes were incorporated to address these issues.

Although no major formatting or script changes were made to the IMM recall as a result of Phase II of Alpha Testing, several small changes were made to improve the usability. Programming glitches were identified and corrected. This testing also produced a great deal of positive feedback and excitement by users. A few quotes include, "Really fun, it's like a game, I want to play again," "Just the bugs need to be worked out---great program," and "After the first food choice the screens became easy."

Final description of the IMM dietary recall

As a result of the two phases of formative testing, the IMM recall has been designed to mimic a multiple-pass food recall. The IMM dietary recall begins with four minutes of introduction/directions, detailing the use of the program. Every choice is made by listening to audio and touching appropriate graphics. Figure 1 shows the steps in which users navigate through the IMM recall. The users first select the eating occasion at which they consumed food/beverages during the previous day. For each eating occasion identified, users navigate through seven main menu screens and identify foods eaten within a group of foods (see Figure 2). After a group of foods have been identified, the user identifies the specific food eaten (see Figure 3). After all the foods have been identified, users identify food variety (regular, low-fat, fat-free), portion size (see Figure 4) and cooking method (see Figure 5). When identifying portion sizes, the smallest portion size is the first image displayed. Users can then touch an arrow on the right side of the screen to interactively grow and shrink portion sizes. The user is instructed to stop on the portion size that looks most like the portion size consumed before proceeding to the next food. Lastly, each eating occasion is displayed with the list of foods the users selected. At this time users are able to add and delete foods. After all the foods have been verified the user exits the program and a text-based logfile is generated. The logfile is imported into the Access™ database to generate a nutrient profile.

Future Research /Application:

After undergoing comparative validation testing, whereby the described IMM recall is tested against an interview-administered recall, the IMM recall will be combined with the previously developed breakfast recall and undergo further qualitative and validation testing. The potential benefits of an IMM dietary recall being as accurate as the current dietary assessment methods are immense. The traditional written forms of dietary assessments are commonly inappropriate for low literate audiences. Interviewed dietary assessments are time consuming and require the use of trained, bilingual interviewers in order to obtain complete and accurate information (Thompson & Subar, 2001). Nutrient analysis of food intake is often a burdensome, multi-step process including collection of dietary information, manual coding of food items, and computerized data entry of food items. Programming the IMM dietary recall system to directly link food choice, portion sizes, and cooking methods to a database will produce instant nutrient data analysis and eliminate data coding and entry errors.

Being aware of these challenges during the development of the IMM recall, and anticipating similar difficulties, may help ease the frustrations of those attempting to develop similar programs in the future. Due to the exploratory nature of the project, unanticipated changes were constantly being recommended and the scope of the program was continuously changing. Changes perceived to be small initially, proved to be very time consuming and challenging for the programmer. As a result, budgetary constraints became a factor. Additionally, the IMM recall was developed using ToolBook™ for CD-ROM, which limits the usability of the program on networked computers. With the exponential improvements made for web-based applications including broader use of structured query language (SQL), it is recognized that the recall should be adapted to this format to optimize reach.

A large number of files, including 960 graphics and 1125 audio files, are represented in the IMM recall. Therefore, establishing a meaningful naming convention is essential. In order for a successful query of the nutrient database, file names from the audio folder and graphic folders need to coincide. This issue needs to be well thought-out prior to programming in order to avoid the labor-intensive task of renaming files.

Due to the large number of foods represented and length of the script, food photography and audio recording occur in many different sessions, resulting in inconsistencies. Special attention should be given to the camera angle and camera distance from foods to avoid complications during editing of the food photographs. Using a professional sound studio and applying a filter during the recording process is highly recommended. This should help improve overall quality of the audio files. These lessons learned will assist in future planning for the continued development and growth of the IMM recall.

This IMM dietary recall will save staff time and resources allowing EFNEP and other food assistance agencies to focus more on nutrition education. The nutrient profile generated by the recall will allow the user to receive specific computerized nutrition messages regarding their diet. The audio and visual cues supported by IMM technology may help stimulate food recall. Additionally, the IMM recall may promote more honest reports of food intake because food choice is disclosed privately without verbal or non-verbal feedback from a staff member.

Overall, the IMM recall has been well received in the peer-review process and has attracted the interest of nutrition educators. This is the first known attempt at developing a food recall into an IMM version that generates a comprehensive nutrient profile. The use of food graphics and audio, combined with the elimination of literacy and keyboarding skills, makes IMM a logical and feasible option for improving the assessment of diet in multiple ethnic groups and populations with low literacy. It is anticipated that the research supported development and extensive formative evaluation process will prove to be extremely valuable during the comparative validation phase.

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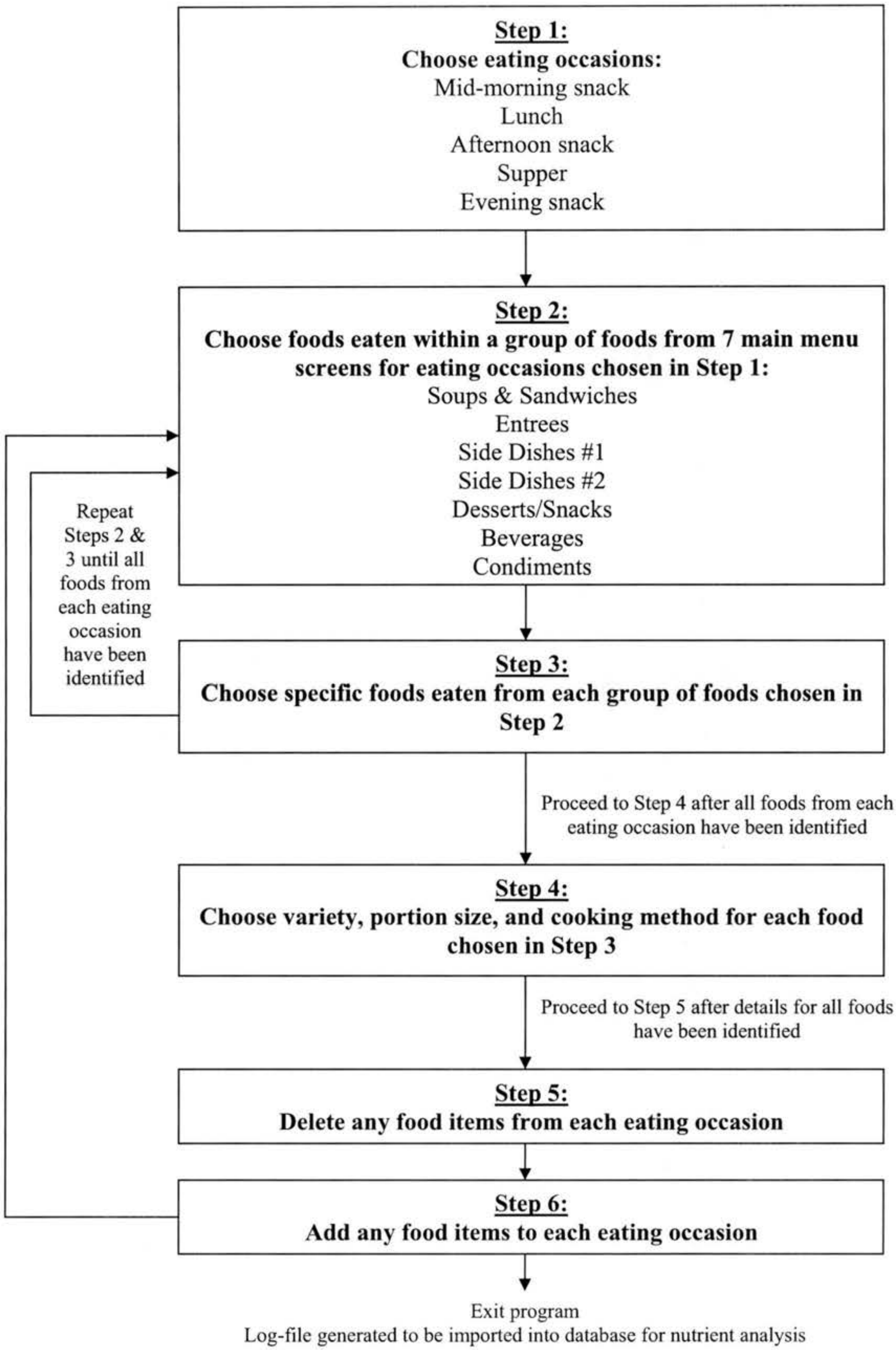

Figure 1. Steps to navigate through the interactive multimedia dietary recall

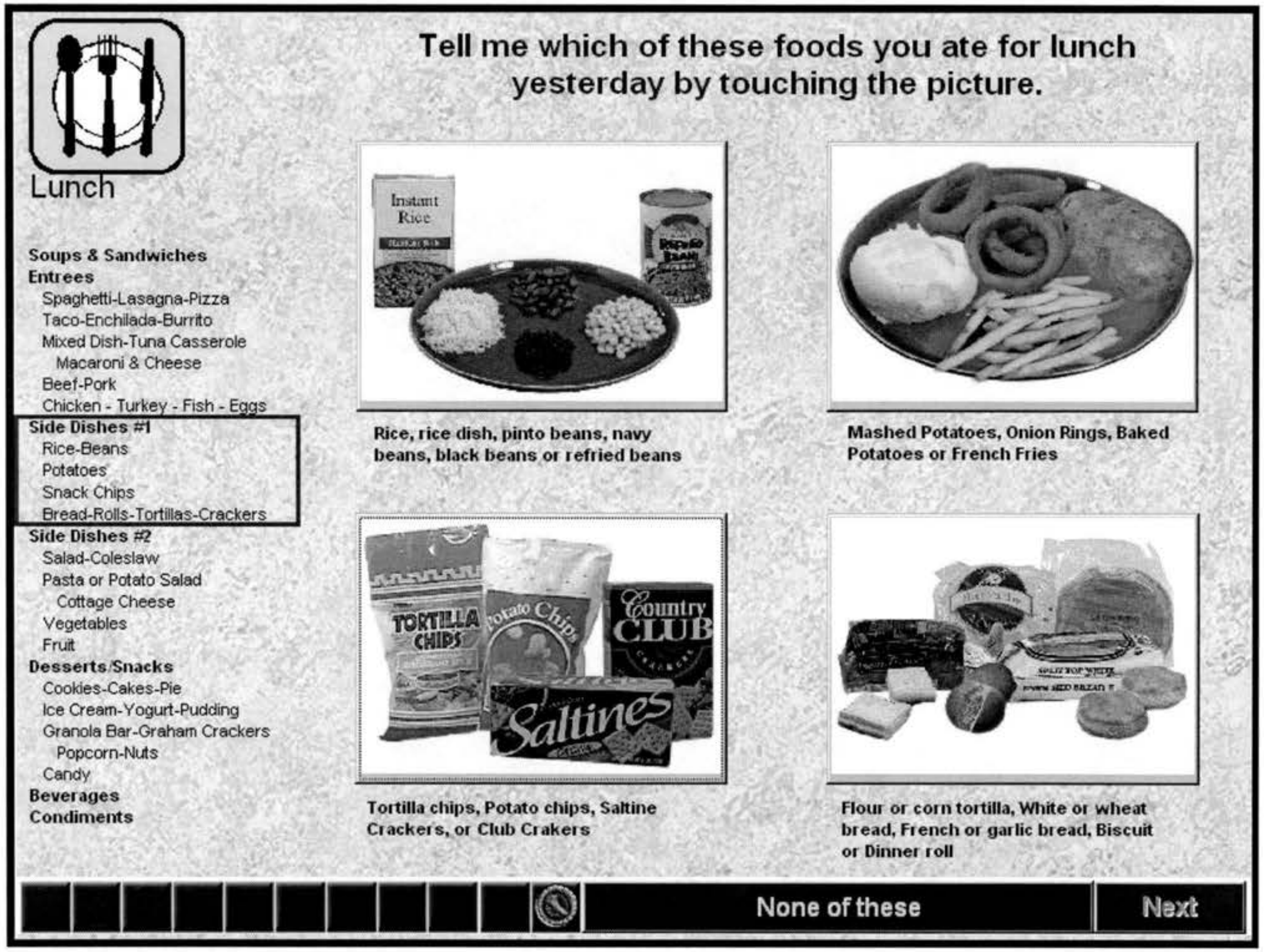

Figure 2. Main menu screen example for Side Dishes #1

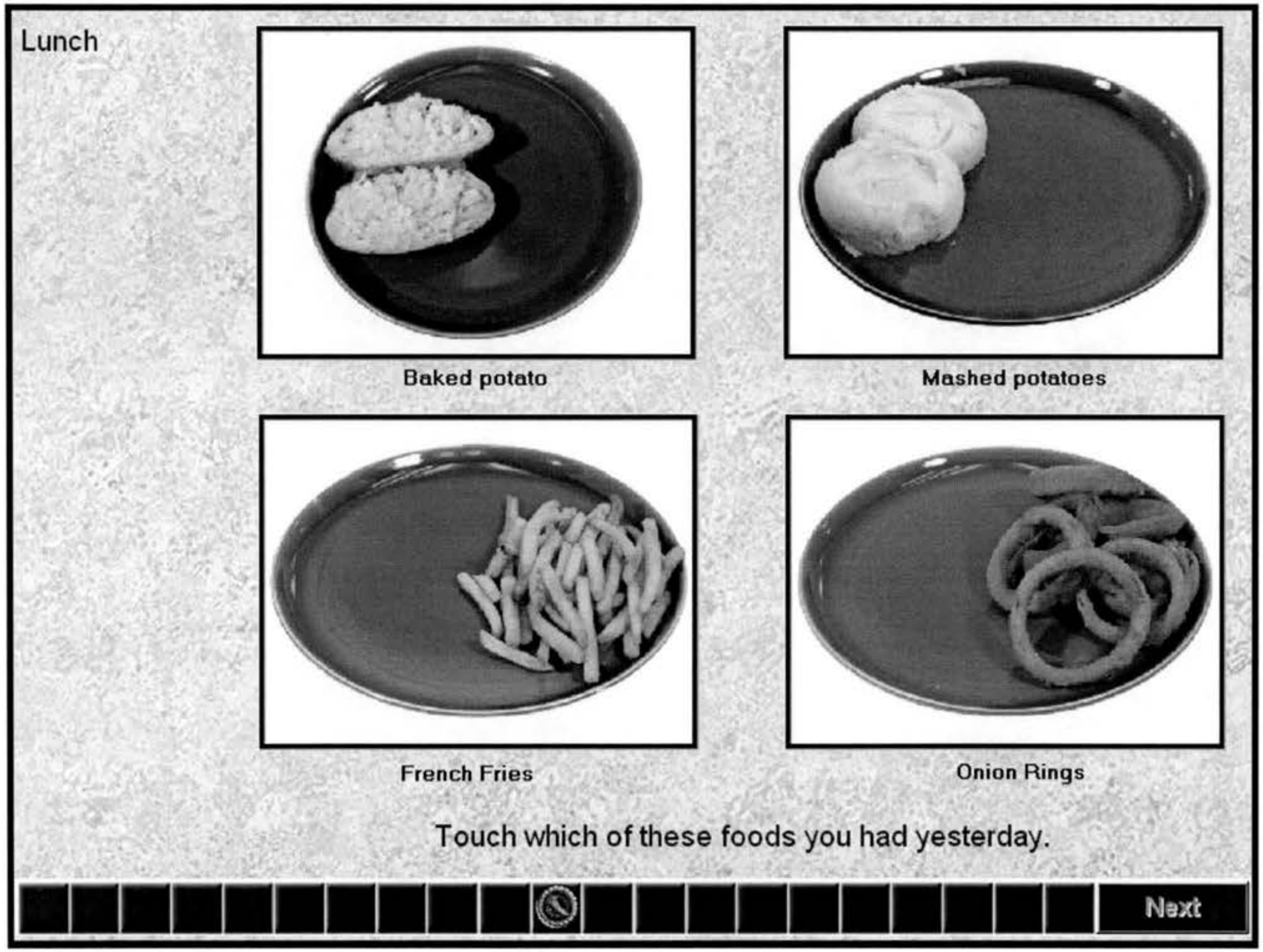

Figure 3. Menu screen example for identifying specific food

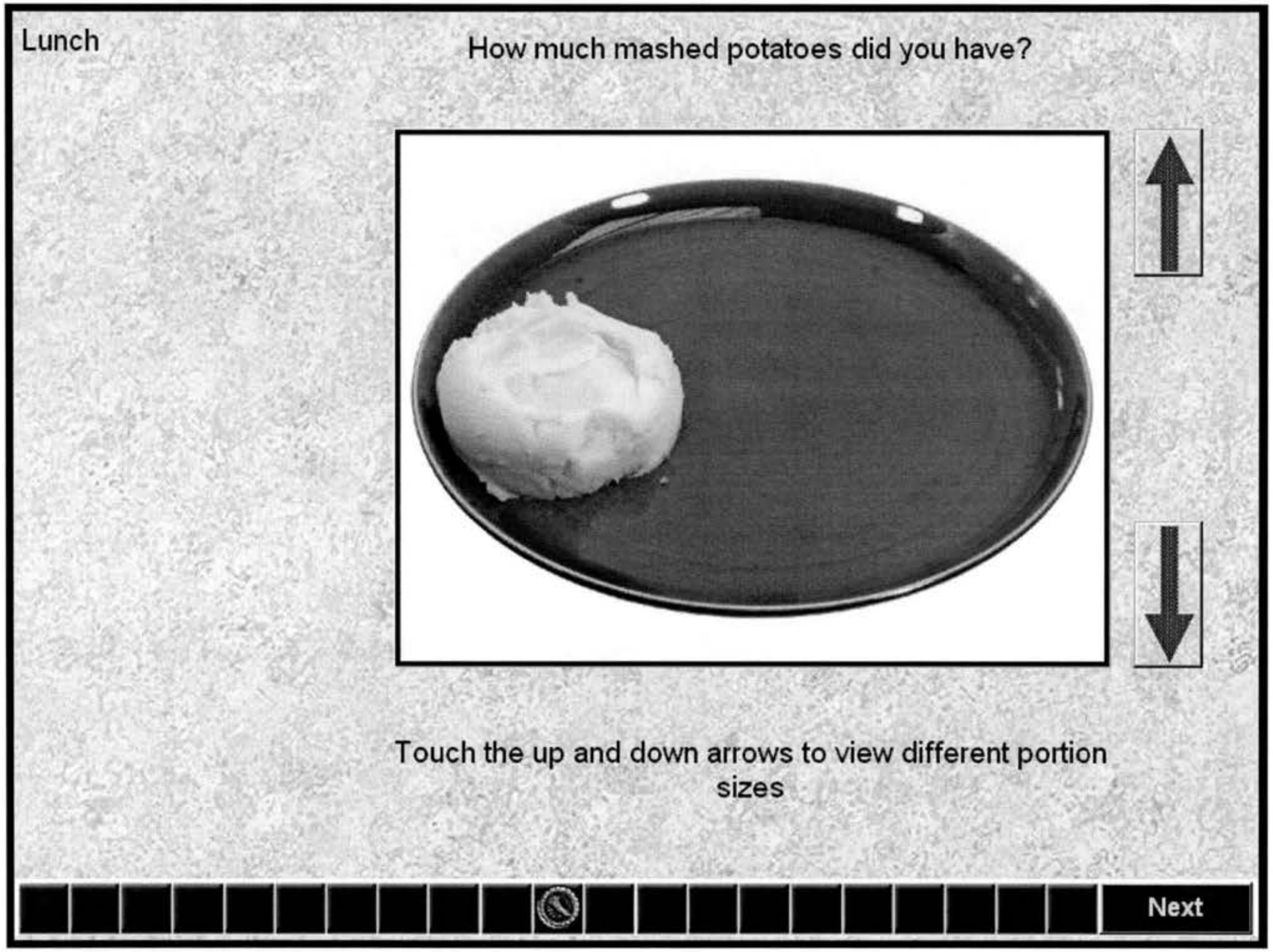

Figure 4. Menu screen example for identifying portion size

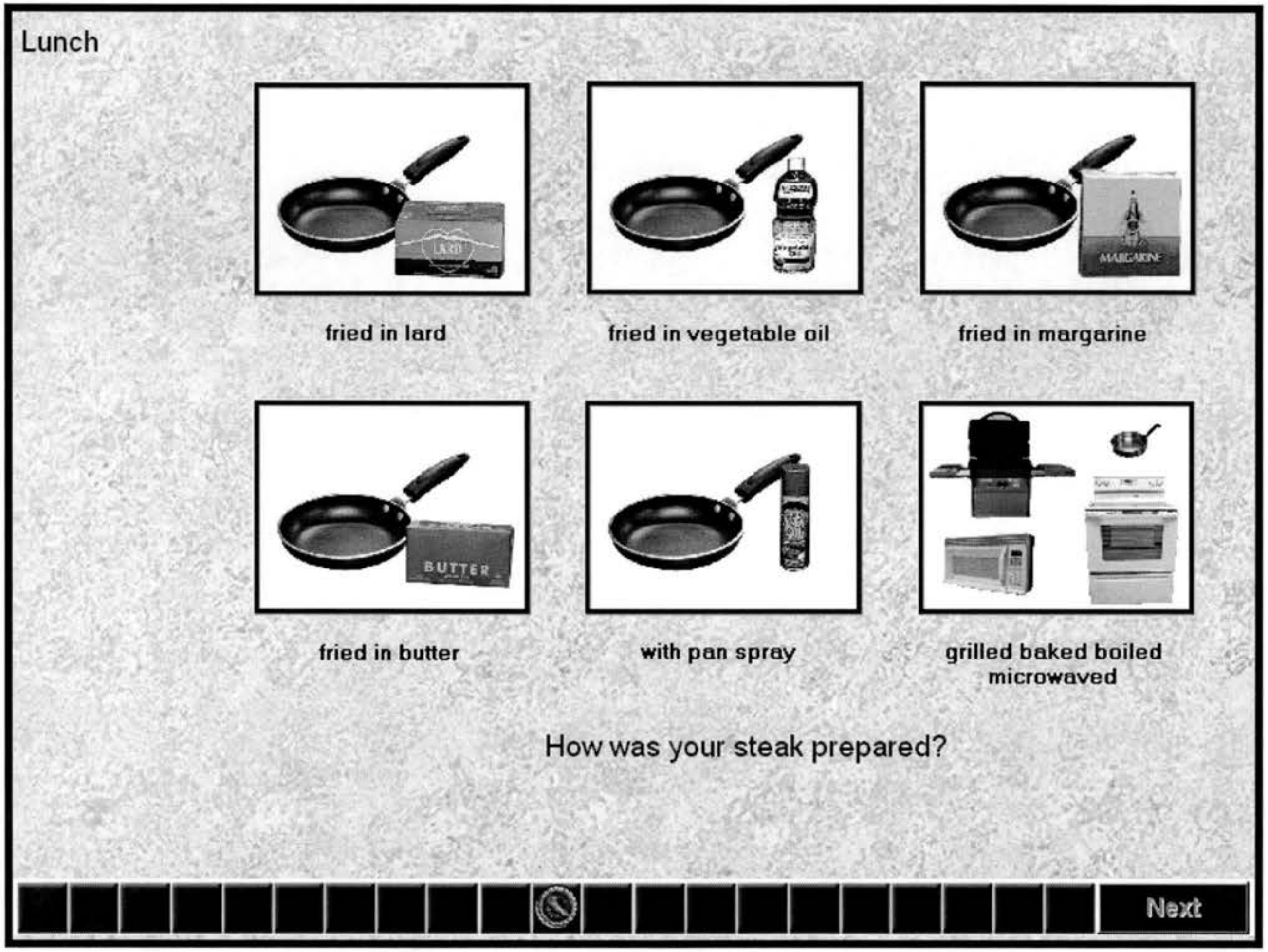

Figure 5. Menu screen example for identifying cooking method

CHAPTER 3: Comparative Validation of a Bilingual Interactive Multimedia Dietary Assessment Tool

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Comparative Validation of a Bilingual Interactive Multimedia Dietary Assessment Tool

ABSTRACT

Objective To perform comparative validity testing for a bilingual interactive multimedia (IMM) dietary assessment tool that mimics a dietary recall against an interview-administered dietary recall.

Design This study was a two-period cross over design study with repeated measures. Participants were randomly assigned to complete an IMM recall or interview-administered 24-hour recall first. The IMM recall generates a nutrient profile, which includes 20 dietary constituents. The interview-administered recall was analyzed using the Food Intake Analysis System (FIAS) and the EFNEP Reporting System (ERS). The effect of substituting standardized portion sizes for reported portion sizes was examined.

Subjects/Setting Of 80 adult Coloradoan participants, 71 (91%) were female, 45 (56%) had $\leq 12^{th}$ grade education, 65 (81%) had $\leq$ \$15,000 annual income, and 21(26%) completed the IMM recall in Spanish.

Statistical analyses preformed Analysis of variance, and unadjusted and energy-adjusted correlations were used.

Results No significant group differences were found for order of administration or demographic characteristics. The only significant method effect found was between the IMM recall and FIAS for vitamin C (P=0.025). The unadjusted correlations between the IMM recalls and interview-administered recalls analyzed using both FIAS and ERS were generally around 0.6. Energy-adjusted correlations were consistently lower. Substituting standardized portion sizes resulted in significant differences for six nutrients and caused all correlations to drop.

Application/Conclusions The results of comparative validity testing and positive reactions received from participants and nutrition educators indicate diet assessment utilizing IMM holds tremendous potential.

INTRODUCTION

Advances in technology have allowed for the use of computers in health and nutrition education. Although computerized interactive multimedia (IMM) for nutrition education has been developed and tested extensively (1-5), there is relatively little research in utilizing IMM for dietary assessment. The traditional methods of dietary assessment, including food frequency questionnaires (FFQ) and 24-hour dietary recalls (24hDR), often are inappropriate or difficult to administer in low-literate and non-English speaking populations. Computerized IMM has the potential of addressing many of the short-comings of these assessment methods including the opportunity to: conduct personalized, in-depth interviews without the costs involved in providing interviewers; obtain standardized collection with appropriate levels of probing; provide instant data entry; give immediate feedback to respondents; ensure that all responses are complete; and provide visual and aural cues to stimulate recall (6). Additionally, IMM is appropriate for use in multiple ethnic groups and populations with low literacy (4, 5).

Low literacy rates (7) and an increasing proportion of Hispanic population (8) in the U.S. are well documented. However, the specialized needs of this socio-culturally diverse population, including an inability to speak and/or read English, is an exclusion factor for many recent studies attempting to improve upon dietary assessment methods (9-11). Providing a bilingual option and/or non-written alternatives to assess diet complicates data collection and the validation of dietary assessment tools. Furthermore, great expense is involved in providing highly trained staff to participate in the multi-step process of dietary assessment including data collection, manual coding and computerized data entry of food items.

Recent studies using unbiased biomarkers for energy and protein raise questions regarding the use of self-reported dietary instruments including both FFQ and 24hDR (11-13). The underreporting of both energy and protein intake when compared to estimates based on doubly labeled water and urinary nitrogen methodologies is consistently demonstrated in the literature (14-17). Despite these findings, biomarker measurements are expensive and feasible biomarkers do not exist for several important nutrients (18). Therefore, self-reported dietary methods continue to be used for assessment of intake in populations and/or individuals, indicating an ongoing need to improve these tools.

There are a variety of limitations with existing IMM dietary assessment tools. First, most are not comprehensive and only look at specific aspects of food intake, for example fat or fruit and vegetable intake (19, 20). Many require some level of literacy and keyboarding skills (19, 21), and none of the existing IMM dietary assessment tools are bilingual (6, 19-22). Finally, little research has been conducted testing the reliability and validity of these instruments.

______________________________ previously developed and performed validity tested for a bilingual IMM dietary recall to assess fat and fiber intake at breakfast in a low-income, low-literate, Hispanic and Caucasian adult population (23). Promising statistical results, combined with overwhelming positive feedback received from participants and nutrition educators, supported further development and testing of an IMM dietary recall. Therefore, the bilingual IMM program was expanded to assess a comprehensive nutrient profile, including 20 dietary constituents, at lunch, supper and snacks; it mimics a multiple pass method. Literacy and keyboarding skills are eliminated with the use of graphics and audio delivered via a touch-screen computer. The purpose of this study was to examine the validity of the IMM dietary recall as compared to an interview-administered dietary recall.

METHODS

Study sample and design

Low-income, low-literate, English- and Spanish-speaking participants were recruited through four agencies serving low-income persons throughout Colorado. Testing sites included 1) Larimer County Special Supplemental Foods Program for Women, Infants and Children (WIC) clinic, Fort Collins, CO, 2) Sunrise WIC clinic, Greeley, CO, 3) Gunnison Family Services building, Gunnison, CO, and 4) Public health clinic building, Pueblo, CO. A power statistic was determined based on the results from the IMM breakfast recall pilot study (23). A sample size of 80 subjects was needed for 80% power to determine a potential methodological difference at a 0.05 significance level. The goal was to have 30% of the participants complete the Spanish version of the program. Both women and men, ages 18-65, were recruited. After individuals signed-in or registered for their appointment at each clinic, a researcher approached the individual to explain the study and recruit the individual as a volunteer. Upon agreement to participate in the study, the participants signed an informed consent form approved by the Human Research Committee at ______________________. Subjects participated in the study after their scheduled clinic appointment was completed.

This study was a two-period cross over design study with repeated measures. Participants completed both an IMM recall and an interview-administered recall, differing only in order of administration. Before beginning the IMM recall, individuals completed a brief demographic section on the touch screen computer, lasting approximately 2.5 minutes. After participants completed both recalls, they were asked to complete a brief opinion survey. The survey included one question concerning how participants preferred to report food intake data as well as two open-ended questions and five questions on a five-point Likert scale to assess the acceptability and user friendliness of the IMM recall.

Interactive Multimedia Dietary Recall

The IMM dietary recall mimics a multiple-pass method. This IMM dietary recall only examined intake at lunch, supper and snacks since an IMM breakfast recall had previously been developed and tested. The IMM dietary recall began with four minutes of directions detailing the use of the recall. Participants were given minimal verbal instructions prior to beginning the IMM recall and a researcher was available to answer questions as needed. Choices were made by listening to the audio and touching appropriate food graphics. Participants first selected which meal times and foods were eaten; then, they reported details related to portion sizes, food variety (fat-free, low-fat), and cooking method; lastly, they were able to add and delete foods.

The IMM dietary recall included 167 food items. Food choice of the target audience was determined by examining the 1982-1984 Hispanics Health and Nutrition Examination Survey (HHANES) (24) and 191 individual 24-hour recalls from Colorado EFNEP participants. Foods reported by greater than 2% of the population in one or both surveys, with a few exceptions, were included. Each food had four different portion sizes, whereby the participant was allowed to interactively grow and shrink the food. The US Department of Agriculture's 1994-1996 Continuing Survey of Food Intake by Individuals (CSFII) *Quantities Consumed per Eating Occasion* for all individuals age 2 and over was used to help determine which portion sizes should be represented (25).

The IMM dietary recall generated a comprehensive nutrient profile, including 20 dietary constituents. The EFNEP Evaluation/Reporting System (ERS) was the primarily nutrient database utilized to identify the dietary composition of included foods because it is the mandatory reporting system used by all EFNEP agencies nationwide. Sources of information for the ERS nutrient database include Agriculture Research Service (ARS) nutrient data, USDA Handbook 8 series, manufacture data, and reliable local data or recipes (26).

Although all users reported portion sizes, the implications of substituting standardized portion sizes for reported portion sizes was examined as a potential way of minimizing participant burden. Standardized portion sizes were derived from the 1994-96 Continuing Survey of Food Intake by Individuals (CSFII) mean *Quantities Consumed per*

Eating Occasion for all individuals age 2 and over (25). However, 57 foods featured in the IMM recall were not included in the CSFII report. Mixed foods such as soups and sandwiches were disaggregated in the CSFII report. For foods featured in the IMM recall, but not listed in the CSFII data, the middle portion size in the Dietary History Questionnaire (DHQ)(27) was used for the standardized portion size. The DHQ is a food frequency questionnaire developed by the National Institutes of Health and has undergone intensive formative evaluation and validation testing. The CSFII data were used to determine portion size ranges in the DHQ.

Interview-administered Dietary Recall

Three trained research interviewers, two bilingual, collected the 24-hour recall information. A multiple pass method was utilized to standardize interview techniques, ensure consistent levels of probing for each participant, and assist participants in recalling foods eaten during the previous day. Food models, measuring utensils, and a ruler were used to help participants identify portion sizes accurately.

The interviewed recall was analyzed using two different nutrient analysis databases including the Food Intake Analysis System (FIAS version 3.99) and the Expanded Food and Nutrition Education Program (EFNEP) Reporting System (ERS). The interview-administered recall analyzed with FIAS was the comparative gold standard in this study. The ERS was also used for analysis because, in large part, the IMM recall was developed for EFNEP participants. Trained staff and standardized protocols were used for data entry into both nutrient analysis databases. Although breakfast information was collected in the interview recalls, breakfast information was not analyzed. This promotes consistency and allows fair comparison of the IMM recall profile in which breakfast intake is not included.

Of the 20 dietary constituents produced from the IMM profile, 14 dietary constituents were comparable to FIAS; the numbers of servings from each food group are not reported in FIAS. A total of 17 dietary constituents from ERS were common to the IMM profile; cholesterol, saturated fat, and folate are not reported in ERS.

Statistical Analysis

Descriptive statistics were carried out to assess demographics, mean nutrient intakes, and findings from the opinion survey. To improve normality of the data, energy and dietary constituents were log transformed. All analyses occurred on the log scale. Two persons were excluded due to incomplete data. Six participants were dropped based on implausible daily energy intake of >4,200 kcal for men or >3,500 kcal for women, as reported in the IMM recall. These exclusions included one English-speaking man with reported intake of 8850 kcal, and three English-speaking and two Spanish-speaking women with reported intakes of 3662, 3761, 4347, 6193, and 8147 kcal.

This report focuses on how outcomes for the IMM dietary recall compared to an interview-administered dietary recall analyzed by FIAS and ERS. Analysis of variance (ANOVA) was used to compare means for nutrient variables from the IMM recall with both methods (FIAS and ERS) used to analyze the interview-administered recall. Both a period and method effect were included in the analyses. Analyses initially included the effects of demographic variables: gender, age, language in which IMM was completed, and education level. Overall the demographic effects were not significant ($P>0.05$), so were removed from the final analyses. It was likely that no gender effect was found due to the small number of men included in this study.

Correlation coefficients were computed to measure the strength of relation between the IMM recall and both methods used to analyze the interview-administered recall. Energy adjusted correlations, using the residual method (18), were also determined. Energy adjusted nutrients provide a measure of nutrient intake uncorrelated with total energy.

Additional ANOVA tests were performed to determine the effect of substituting standardized portion sizes for reported portion sizes in the IMM recall. Furthermore, correlation coefficients were computed to compare the IMM dietary recall using reported versus standardized portion sizes with the interview-administered recall analyzed using FIAS.

RESULTS

Table 1 presents the demographic characteristics of the 80 participants included in the analyses, after excluding eight participants as previously explained. Participants were primarily low-educated, low-income women.

Table 2 shows the mean and standard deviations for energy and all dietary constituents for the IMM recall and interview-administered recall analyzed using FIAS and ERS. It is important to note that the means in Table 2 include lunch, supper, and snacks; breakfast is excluded. Additionally, both genders are included. There were no significant period effects, hence no significant differences when the IMM recall or the interview-administered recall was performed first. The only significant method effect was between the IMM recall and FIAS for vitamin C (p=0.025).

Table 3 shows the estimated unadjusted and energy-adjusted correlation coefficients between the interview administered recall, analyzed using FIAS and ERS, and the IMM recall as completed by the participant using reported portion sizes. Unadjusted correlations between the IMM recall and the FIAS analyzed recall were generally close to 0.6; notable exceptions include folate at 0.22 and alcohol at 0.99. Unadjusted correlations between the IMM recall and ERS analyzed recall were also generally close to 0.6; notable exceptions include fiber at 0.34, vitamin B6 at 0.33, and alcohol at 0.99. After adjusting for energy, correlation coefficients consistently decreased.

Table 4 displays a consistent drop in correlations when reported portion sizes were replaced with standardized portion sizes in the IMM recall as compared to the interview administered dietary recall analyzed using FIAS. ANOVA tests (data not shown) revealed significant differences when using standardized portion sizes as compared to the interview-administered recall analyzed using FIAS for the following nutrients: carbohydrates (p<0.007), vitamin A (p<0.001), vitamin C (p=0.002), calcium (p=0.011), dairy servings (p=.011), and other servings (p=0.032). Furthermore the following nutrients approached significance: protein (p=0.053), vitamin B6 (p=0.064), and alcohol (p=0.090).

The time required to complete the IMM recall, interview-administered recall, and data entry into FIAS was also recorded. The average time to complete the IMM recall was 16 minutes and 30 seconds; this included four minutes of introduction/directions. The average time to collect the interview-administered 24-recall was approximately 13 minutes, while the average time to analyze the recall using FIAS was approximately 7 minutes, for a total combined average time of 20 minutes.

The opinion survey revealed the majority of participants, 53%, preferred to use the touch-screen computerized recall to report food intake; 39% preferred an interviewer, and 8% preferred the pencil/paper method. Although the pencil/paper method was not used in this study, this preference option was included because it is the method used by EFNEP. The mean score of each 5-point Likert scale question received high ratings including touch screen computer easy to use (M=4.6), introduction/directions helpful (M=4.4), meal times understandable (M=4.7), foods easy to identify (M=4.4), portions easy to identify (M=4.6), and computer food recall easy to use (M=4.6). Overall feedback received from the target audience and the nutrition educators at testing site was extremely favorable towards the IMM food recall.

DISCUSSION

Based on the demographic results, it is clear the validity testing occurred within the intended audience. Since breakfast is excluded and both genders are represented, it is difficult to compare the nutrient intakes obtained from the IMM recall to the findings in similar dietary assessment research and validation studies. However, the fact that no significant method effect (excluding vitamin C) was found, as compared to an interview-administered recall, provides reassurance that the IMM recall was comprehensive.

Validation studies usually have involved comparing a FFQ to another criterion method, frequently multiple 24-hour recalls or food records. Correlation coefficients for these types of studies were found in the range of 0.4 to 0.7 (18, 28). In this study, two different methods of administering a 24-hour recall were being compared. It may be argued that when selecting a criterion method of validation, it is important that the errors of both methods be as independent as possible. In this research, some sources of error may have tended to track together including memory, perception of serving size, and nutrient analysis database. On the other hand, other sources of error were uncorrelated including method to collect information, method used to assist in identifying portion sizes (food models versus food photography), and no restrictions versus restrictions imposed by fixed list of foods and portion sizes. The correlation results in this study, approximately 0.6, were similar to other studies. This indicates the IMM recall is as good as the interview-administered recall with which it was compared. Correlations in this range generally are considered to be satisfactory for making inferences about intakes by groups of individuals in epidemiologic research; however, such data cannot accurately classify individuals as above or below set cut-off points.

Energy-adjusted correlations are used when interested in dietary composition independent of total energy intake, especially when energy intake is associated with disease, and used to control for measurement error. Although energy adjustment improves correlation between FFQs and true intake measured by multiple 24-hour recalls (9), this is not true for all dietary assessment instruments. Kipnis and colleagues have shown how the unadjusted and energy-adjusted correlation depends on the measurement error structure of the instrument (13).

In this study, after adjusting for energy, correlation coefficients consistently decreased. This can be explained by the fact that energy between the IMM recalls and interview-administered recalls were highly correlated prior to adjustment (0.74 for both

ERS and FIAS). Since energy-adjusted correlations provide a measure of nutrient intake uncorrelated with total energy, the energy-adjusted nutrients consequently decreased. Schatzkin and colleagues recently found that energy-adjusted protein intake led to a slight decrease in correlation between a 24-hour recall and true intake measured by urinary nitrogen for women (12). Our data, comprised primarily of women, supports those findings by Schatzkin and colleagues, in that energy-adjusted correlations decreased.

Many issues must be considered when attempting to assess portion sizes of food consumed with self-reported dietary intake. It is well known that individuals have a difficult time estimating food quantities (29-31). Due to the difficulties in reporting portion sizes many researchers have studied the impact of replacing reported portion sizes with standard portion sizes. Several investigators have found that little extra information was gained by including individual portion size information (32, 33). Previous research conducted at Colorado State University with an IMM breakfast recall revealed no significant differences in fat or fiber when standardizes portion sizes were substituted for reported portion sizes (23). On the contrary, numerous other studies have demonstrated significant impacts of substituting standard portion sizes with reported portion sizes (34-36). A recurrent theme demonstrated in the literature has been the tendency for the standard portion sizes to underestimate dietary intake. Standard portion sizes are often based on CSFII data (37).

Research using standardized portions generally has been conducted with FFQ or multiple day food recalls. Using standardized portion sizes in a single 24-hour recall may be questionable, yet would reduce the time required to complete the IMM dietary recall and minimize participant burden. However, ANOVA tests revealed six nutrients were significantly lower when standardized portion sizes were substituted for reported portion sizes. This finding supports previous research that standardized portion sizes underestimate intake. Due to this finding and the fact that correlations between nutrient analysis using reported portion sizes and nutrient analysis using standardizes portion sizes consistently dropped, using standardized portion sizes is not a feasible option in the IMM recall.

Baranowski and colleagues also have developed a 24-hour recall, the Food Intake Recording Software System (FIRSSt), into an IMM format to facilitate fourth-grade children's self-report of diet. While FIRSSt was found to be somewhat less accurate than a dietitian-conducted 24hDR, the researchers found it to be a promising method for assessing diet. The statistical analysis for validity of FIRSSt focused on foods matched to the criterion method (21), as opposed to assessing dietary constituents as in this research.

Using IMM technology to assess food intake has some limitations. The open-ended format of a 24-hour recall is forfeited when using an IMM format, which cannot accommodate an unlimited level of specificity regarding food choice. Another potential challenge is use of discrete portions to represent food items in the IMM dietary recall system. Overall, the IMM format forces a certain level of standardization that may result in obtaining less accurate information. However, through the use of both local food choice information and national data on food choice and portion sizes, great efforts were made to include foods and portion sizes in the IMM dietary recall system that best represent the intakes of low-income, Hispanic, Colorado residents.

In many other ways, the IMM format holds many advantages relative to current methods of assessing dietary intake. Pencil and paper methods are inappropriate for low-literate audiences and often lead to incomplete data collection. IMM provides an opportunity to conduct personalized and in-depth assessments in multiple ethnic groups and populations with low literacy without the expense involved in providing interviews. Audio and visual clues are provided to help stimulate recall. Furthermore, the IMM method provides instant data entry. This eliminates error, estimation, and bias from having a third party enter the data. Minimizing measurement error is a key element to a successful diet assessment program. As noted earlier the IMM recall took approximately 16 minutes and 30 seconds, whereas total time to collect and analyze the interview-administered 24-recall was approximately 20 minutes. Not only is there a net time savings, but the IMM method does not require the use of trained staff. Future research should be conducted to examine the cost effectiveness of utilizing IMM for dietary assessment.

Positive reactions from both participants and nutrition educators and results of validity testing, indicate IMM is a viable alternative for collecting dietary information. There are several key improvements that will be incorporated to improve the program's usability and collection of dietary information.

In the future the breakfast component will be combined with the lunch, supper, and snack components and retested for validity. Future statistical analyses should examine the accuracy of reported foods in the IMM recall measured in terms of matches, intrusions, and omissions as compared to an interview-administered recall. If the IMM dietary recall system is to be used for a larger audience, the economic, social, cultural, and geographical factors related to food choice will need to be considered. The 167 food items currently represented in the IMM dietary recall will need to be expanded to accurately represent food choice of other regions. Furthermore there is great potential to utilize technology and the lessons learned from this research study to develop a FFQ into an IMM format.

CONCLUSIONS

- The IMM dietary recall is a valid method for assessing dietary intake within groups of individuals.
- The IMM dietary recall can directly link food choice, portion sizes, and cooking methods to generate a nutrient profile. Instant data entry can save staff time and resources and allow more time to be spent on nutrition education instead of dietary analysis.
- IMM technology can allow dietary assessment in those underserved populations that are commonly excluded from research studies due to the inability to read and/or write English, including low-literate and multiple ethnic group populations.
- The use of computer-tailored nutrition education has exploded in recent years. There is great potential to interface results from an IMM generated nutrient profile with specific nutrition education messages aimed at improving food choice and dietary patterns.

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Table 1. Demographic Characteristics of Participants (N=80)

Characteristic	Number	%
Gender		
Women	73	91.2
Men	7	8.8
Age group (years)		
18-39	57	71.3
40-59	21	26.2
60-65	2	2.5
Language (IMM)[a]		
English	59	73.8
Spanish	21	26.2
Education		
$<12^{th}$ grade	28	35.0
12^{th} grade or diploma	28	35.0
$>12^{th}$ grade	24	30.0
Annual household income		
< \$10,000	36	45.0
\$10,000-\$15,000	29	36.3
> \$15,000	15	18.7

[a]language chosen to complete interactive multimedia (IMM) dietary recall

Table 2. Means and standard deviations (SD) for participants completing interactive multimedia (IMM) and interview-administered dietary recalls. (N=80)

	IMM Method		Interview Method			
	IMM nutrient analysis[a]		FIAS nutrient analysis[b]		ERS nutrient analysis[c]	
Dietary constituent	Mean	SD	Mean	SD	Mean	SD
Energy (kcals)	1783	840	1770	874	1743	810
Protein (g)	68.7	35.5	70.9	40.0	68.4	36.1
Total fat (g)	70.6	40.0	72.0	40.5	70.2	38.0
Carbohydrates (g)	224.0	114.9	211.5	125.8	208.8	109.5
Dietary fiber (g)	15.9	22.2	13.9	8.9	20.8	66.9
Alcohol (g)	1.8	6.5	1.9	7.1	1.7	6.4
Vitamin A (RE)[d]	836.7	1076	734.5	942.6	671.9	103.2
Vitamin C (mg)	132.8	154.37	101.5*	157.0	124.3	181.8
Calcium (mg)	687.7	404.6	757.8	535.1	784.0	697.3
Iron (mg)	10.2	5.8	10.8	5.7	10.9	6.0
Vitamin B6 (mg)	1.5	1.1	1.4	0.8	2.4	8.8
Folate (mcg)	284.4	212.0	305.6	205.0		
Saturated Fat (g)	23.7	14.3	26.5	19.0		
Cholesterol (mg)	194.2	149.5	209.2	162.7		
Meat Servings (#)	2.2	1.4			2.0	1.3
Dairy Servings (#)	1.8	1.7			1.7	1.8
Vegetable Servings (#)	3.4	3.2			2.8	2.4
Bread Servings (#)	5.0	3.4			4.3	2.4
Fruit Servings (#)	1.9	2.8			1.9	3.2
Other Servings (#)	18.4	12.5			18.0	12.6

[a]IMM nutrient analysis using reported portion sizes
[b]FIAS, Food Intake Analysis System
[c]ERS, Expanded Food and Nutrition Education Program (EFNEP) Reporting System
[d]RE, retinol equivalent.
*$P = 0.025$, compared with IMM method

Table 3. Unadjusted and energy-adjusted correlations between the interview-administered dietary recall nutrient analyses and the interactive multimedia (IMM) dietary recall analysis[a]. (N=80).

		Interview Method	
Dietary constituent		**FIAS[b] nutrient analysis**	**ERS[c] nutrient analysis**
Energy	Unadjusted	0.74	0.74
Protein	Unadjusted	0.55	0.56
	Adjusted	0.42	0.46
Total fat	Unadjusted	0.44	0.43
	Adjusted	0.26	0.27
Carbohydrates	Unadjusted	0.78	0.80
	Adjusted	0.45	0.53
Dietary Fiber	Unadjusted	0.40	0.34
	Adjusted	0.39	0.26
Alcohol	Unadjusted	0.99	0.99
	Adjusted	0.99	0.99
Vitamin A	Unadjusted	0.65	0.52
	Adjusted	0.65	0.50
Vitamin C	Unadjusted	0.55	0.59
	Adjusted	0.50	0.57
Calcium	Unadjusted	0.70	0.71
	Adjusted	0.64	0.60
Iron	Unadjusted	0.47	0.49
	Adjusted	0.24	0.32
Vitamin B6	Unadjusted	0.61	0.33
	Adjusted	0.60	0.28
Folate	Unadjusted	0.29	
	Adjusted	0.15	
Saturated Fat	Unadjusted	0.47	
	Adjusted	0.40	
Cholesterol	Unadjusted	0.59	
	Adjusted	0.55	
Meat Servings	Unadjusted		0.49
	Adjusted		0.40
Dairy Servings	Unadjusted		0.71
	Adjusted		0.69
Vegetable Servings	Unadjusted		0.61
	Adjusted		0.61
Bread Servings	Unadjusted		0.68
	Adjusted		0.63
Fruit Servings	Unadjusted		0.82
	Adjusted		0.79
Other Servings	Unadjusted		0.75
	Adjusted		0.62

[a]IMM nutrient analysis using reported portion sizes
[b]FIAS, Food Intake Analysis System
[c]ERS, Expanded Food and Nutrition Education Program (EFNEP) Reporting System

Table 4. Unadjusted correlations between the interactive multimedia (IMM) dietary recall using reported versus standardized[a] portion sizes and the FIAS[b] analyzed interview-administered dietary recall (N=80).

	IMM Method	
Dietary constituent	IMM nutrient analysis using reported portion sizes	IMM nutrient analysis using standardized[a] portion sizes
Energy	.74	.55
Protein	.55	.37
Total fat	.44	.35
Carbohydrates	.78	.64
Dietary Fiber	.40	.33
Alcohol	.99	.97
Vitamin A	.65	.62
Vitamin C	.55	.55
Calcium	.70	.58
Iron	.47	.34
Vitamin B6	.61	.57
Folate	.29	.22
Saturated Fat	.47	.38
Cholesterol	.59	.53

[a]Standardized portion sizes are based on the 1994-96 Continuing Survey of Food Intake by Individuals quantities consumed per eating occasion for all individuals age 2 and over.
[b]FIAS, Food Intake Analysis System

CHAPTER 4: Qualitative Assessment & Recommendations

In addition to the quantitative statistical analyses comparing nutrient profiles among the different methods, the accuracy of foods and portion sizes reported in the IMM recall were compared to the interview-administered recall. The purpose of this analysis was to determine if foods and portion sizes represented in the IMM recall truly captured the intake of the target population.

Methods:

Foods that were reported in the interview but not available in the IMM recall were recorded and then compared to the text-based logfile (generated by the IMM recall) to determine if the user chose an appropriate substitution. The goal of this analysis was two-fold, first to determine if additional foods should be included in the recall and second to determine if subjects were able to select the foods they had eaten from a basic list of generic foods. For example, the IMM recall only features chocolate chip cookies, and it needed to be determined if subjects would chose the chocolate chip cookie regardless of the specific type of cookie they consumed.

Portion sizes that were reported in the interview but not available in the IMM recall were also recorded. A portion size reported by the subject in the interview was determined unavailable if it did not fall within the range of available portions in the IMM recall. For example, the portion sizes available for milk are 1, 2, 3, and 4 cups. If a subject reported ½ cup of milk, it was recorded as unavailable. However, if the subject reported 1-½ cups of milk, this falls within the range of available portion sizes and therefore was not noted. The goal of using this criterion was to identify potential errors in nutrient profiles due to unavailable portion sizes.

All of the available foods in the IMM recall for all 80 subjects were also examined for frequency of selection. The goal of this analysis was to identify foods chosen most and least often. Those foods rarely selected could potentially be eliminated from the IMM recall to simplify the usability of the program.

The feedback obtained from the open-ended questions of the opinion survey was also evaluated. The participants comments combined with the researchers' observations were examined to identify and prioritized future improvements of the IMM food recall.

Results/Discussion:

Tables 1a-1e display the foods reported in the interview recall that were unavailable in the IMM recall, and the food chosen as an appropriate substitution. Overall the subjects did a very good job at identifying and choosing an appropriate substitution in the IMM recall. However, based on these results there are a few foods that should be added to the IMM recall based on the frequency of reporting or the fact that appropriate substitutions could not be identified. Listed below are specific recommendations:

1. Tostada should be included on the Main Dishes page.
2. Chocolate milk and hot chocolate should be included on the Beverages page.
3. Oil and vinegar should be included as a choice for salad dressing.
4. Ranch dressing for dipping should be included on the Condiments page (in addition to embedded into the salad page).

5. Cheese should be included on the Condiments page (in addition to embedded into the sandwiches page).
6. Peanut butter should be included on the Condiments page (in addition to embedded into the sandwiches page).
7. When the breakfast component is combined with the lunch, supper and snacks component, foods such as cereal and donuts should be available at each eating occasion.
8. Similar to building a sandwich, users should be provided an option to build foods with a tortilla base, for example tacos, tostadas, burritos, fajitas, and chimichangas.

Tables 2a-2b display portion sizes reported in the interview recall and the closet portion available in the IMM recall. Overall the portion sizes in the IMM recall were an excellent representation of the portion sizes reported in the interview. However, based on these results there are a few portions of foods which should be added to the IMM recall. Listed below are specific recommendations:

1. Include smaller portions for chili, beginning with ¼ cup. Chili was often reported as a topping on a food rather than as the entrée.
2. Include smaller portions for crackers, beginning with 3 crackers.
3. Include larger portions for cookies, ending with 6 cookies.
4. Include smaller portions for lemonade, beginning with 8 ounces.
5. Include smaller portions for salsa, beginning with 1 Tablespoon.
6. Include smaller portions for salad dressing, beginning with 1 teaspoon.

7. Include smaller portions for mayonnaise, beginning with 1 teaspoon.

Table 3 reveals participants did not frequently select modified fat varieties of foods. Table 4 displays the foods that were reported by zero or one of the 80 participants in the validation study. See Appendix B for a complete list of the frequency of foods reported by subjects.

Modified fat varieties of food items were illustrated in the IMM recall, even though they were not frequently reported in the HNANES or EFNEP recalls. Vandenlangenber and colleagues suggested that close ended questionnaires may yield overestimation of fat intake because subjects are not given the option of reporting low-fat varieties of food choices (Vandenlangenberg et al., 1997). Our findings do not support this claim, because overall participants did not frequently select modified fat foods. However, these foods should not be removed from the IMM recall, because if used to evaluate a nutrition education program, these foods would be helpful in determining behavior modification.

In the future foods rarely chosen, excluding modified fat varieties of foods, should be considered for removal in order to streamline the program flow. However, it is premature to remove foods based solely on this validation study. The data collection for this study occurred in May, June and August. Even though seasonality of food choice was considered in determining which foods should be included in the IMM recall, the data collection period clearly does not represent all seasons. If the data collection would have occurred across all seasons, the frequency of consumption for some foods, especially the soups and canned fruits, may have been much greater.

In addition to the previous recommendations, feedback was obtained from the open-ended questions on the opinion survey. It light of participants' comments as well as observations from the researchers' the following changes are recommended:

1. Condense the introduction/directions, four minutes is too long.
2. Provide an option to skip introduction/directions. This will be especially important for future use when there may be repeat users.
3. Provide an option for new users to practice using the program prior to recording choices in the log-file. This would allow users to explore links before entering actual food choices.
4. Provide an option to pause the program if users get distracted.
5. Record audio files a bit faster, some user's felt the program flow was to too slow.
6. Record all audio files in a single session with appropriate filters applied during recording, as opposed to during the editing process.
7. The add/delete screen should show actual food graphics instead of listing of food names.

Summary:

Overall the participants were successful at recognizing and selecting foods in the IMM recall that were similar to foods reported in the interview-administered recall. The portion sizes in the IMM recall accurately represented the portion sizes reported in the interview. Although modified fat varieties of foods were not frequently chosen, it is important to include these foods if the IMM recall is to be used for nutrition education program evaluation and tracking behavior modification. It is not advised to exclude any foods based solely on this study, because all seasons were not represented in the data collection period. The participants' comments and researchers' observations will be helpful in improving the usability of the IMM recall.

Table 1a. Foods reported in the interview recall compared to foods chosen in the IMM recall.

Soups & Sandwiches	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
BBQ chicken sandwich	chicken sandwich
fish sandwich	fish & white bread
Rueben sandwich	wheat bread, salami & cheese
Philly steak sandwich	sub sandwich
pastrami & cheese on tortilla	roast beef
hot dog on croissant roll	hot dog on bun
pastrami	salami
peanut butter off spoon	peanut butter on bread
chicken & rice soup	chicken leg and rice
miso soup	broth soup

Main Dishes	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
alfredo noodles	spaghetti
elk steak	beef steak
Pizza lunchable	pizza
Ham & cheese lunchable	Turkey sandwich and crackers
baked ham	roast beef
spam	ham
ground turkey	baked turkey
shrimp	fish
fresh tuna fillet	fish
whole wheat spaghetti	spaghetti
shrimp	fish
shrimp	none
crab	none
sushi	fish
chicken nuggets	chicken breast sandwich
fried catfish	fish
fajita	burrito
beef chimicanga	burrito
chimicanga	burrito
chimicanga	burrito
steak chalupa	taco
crunchy gorditos	burrito
Quesadilla	corn tortilla
tostada	corn tortilla & black beans
tostada	taco and flour tortilla
tostada	taco
tostada	none

Table 1b. Foods reported in the interview recall compared to foods chosen in the IMM recall.

Side Dishes #1	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
triscuits	saltine crackers
Wassa bread crackers	saltine crackers
baked beans	none
kidney beans	pinto beans
sweet potato	baked white potato
tatter tots	French fries
quinoa	none

Side Dishes #2	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
alphalpha	none
honeydew	cantaloupe
fried eggplant	none
Zucchini & mushrooms	mixed vegetables
spinach salad	lettuce salad
spinach salad	lettuce salad
grapefruit	orange
dried prunes	none
breaded eggplant	mixed vegetables
cooked cabbage	none

Table 1c. Foods reported in the interview recall compared to foods chosen in the IMM recall.

Desserts/Snacks	
Food Reported in Interview Recall	Food Reported in the IMM Recall
milk shake	ice cream
chocolate chip ice cream	ice cream
banana berry ice cream	ice cream
orange sherbet	ice cream
cherry vanilla ice cream	ice cream
fudge bar	ice cream
chocolate ice cream	ice creams
mint chocolate ice cream	ice cream
popsicle	none
lemon meringue pie	ice cream
Carb solution bar	granola bar
doughnut	cake
doughnut	cake
muffin	cake
whip cream	none
chocolate syrup	none
handi snack crackers	none
trail mix	mixed nuts
sunflower seeds	none
walnuts	none
sunflower seeds	none
almonds	mixed nuts
raisins	none
thin mint cookie	cookie
Oreos	none
macadamia nut cookie	cookie
caramel & cream filled candy	chocolate candy
Twix candy bar	candy bar
shock tarts	hard candy
M & M	none
pecan delight candy	chocolate candy
M & M	candy bar
cinnamon sticks w/ icing	cake
cinnamon sticks w/ icing	none
corn chips	tortilla chips
cheetos	none
Doritos	tortilla chips
Doritos	tortilla chips
Doritos	tortilla chips
Doritos	none
Doritos	tortilla chips
Doritos	tortilla chips
Doritos	none
Doritos	tortilla chips
baked chips	chips

Table 1d. Foods reported in the interview recall compared to foods chosen in the IMM recall.

Beverages	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
Cherry Slice Soda	soda
grape soda	2 L soda
strawberry limeade	soda
Code red soda	fountain soda
crystal lite	none
soymilk	skim milk
chocolate milk	2% milk
Nesquick for chocolate milk	none
hot chocolate	milk
powdered chocolate	milk
Carnation Instant Breakfast	Milk
pear juice	orange juice
mango juice	orange juice
dry powdered tea	hot tea
rice drink	lemonade

Condiments	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
Garlic sass dressing	ranch dressing
tomato basil dressing	none
oil & vinegar	none
oil & vinegar	none
balsamic vinegar	none
vinegar dressing	Italian dressing
bleu cheese dressing	none
Ranch for dipping hot wings	none
ranch for dipping	none
ranch dressing on sandwich	mayo

Table 1e. Foods reported in the interview recall compared to foods chosen in the IMM recall.

Miscellaneous	
Food Reported in Interview Recall	**Food Reported in the IMM Recall**
cheese in tuna sandwich	none
Cheese on hot dog	none
Cheese on fish sandwich	none
Cheese on quesadilla	none
Nacho cheese sauce	none
Mozzarella cheese slice	none
pepper jack cheese	none
cheese on tatter tots	none
cheese on hot dog	none
cheese on tostada	none
Romano cheese	none
feta cheese	shredded white cheese
cheese on fries	none
cheese	none
cheese	none
fresh cheese	none
Colby cheese	none
corn flakes	none
corn flakes	none
oatmeal	none
cream of wheat	none
fruit loops	none
reces peanut butter cereal	none
Cheerios	none
egg on salad	none
hummus	navy beans
liverwurst	none
tuna/broccoli quiche	none
one slice white & wheat on sandwich	wheat bread
whipping cream	none
pimentos	none
coconut	none

Table 2a. Portion sizes reported in the interview recall and the closest portion available in the IMM recall.

Soups & Sandwiches	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
1/8 cup chili	1 cup chili
1 T chili	1 cup chili
1/2 cup chili	1 cup chili
4 bologna sandwiches	3 bologna sandwiches
1 tsp jelly	1 Tbsp jelly
1 tsp peanut butter	1 Tbsp peanut butter
1/2 oz turkey	1 oz turkey
Main Dishes	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
1 large pizza	4 slices
1 1/2 oz chicken	3 oz chicken
1/2 oz cheese	1 oz
1/2 enchilada	1 enchilada
1/2 chimicanga	1 burrito
1/8 cup ground beef	3 oz beef
18 oz beef	12 oz beef
18 oz chicken	12 oz chicken
Side Dishes #1	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
3 cups refried beans	1 cup refried beans
1/4 cup mashed potatoes	1/2 cup mashed potatoes
1 tube Ritz crackers	24 crackers
3 crackers	6 crackers
3 crackers	6 crackers
Side Dishes #2	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
4 cups strawberries	1 1/4 cups strawberries
1/8 cup green peppers	1/4 green peppers
1/3 cup green beans	1/2 cup green beans
1/4 cup corn	1/2 cup corn

Table 2b. Portion sizes reported in the interview recall and the closest portion available in the IMM recall.

Desserts/Snacks	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
1 graham cracker	2 crackers
4 cups M & M	2 oz chocolate candy
2 cups popcorn	3 cups popcorn
1 cup popcorn	3 cups popcorn
6 cookies	4 cookies
5 cookies	4 cookies
5 cookies	4 cookies
5 cookies	4 cookies
1/4 cup ice cream	1/2 cup ice cream
1 cup shocktarts	2 oz hard candy
Beverages	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
4 oz beer	12 oz beer
6 oz milk	8 oz milk
1/8 cup milk (in tea)	1 cup milk
72 oz coffee	32 oz coffee
144 oz coffee	32 oz coffee
5 oz soda	12 oz soda
1/2 soda	12 oz soda
8 oz coke	12 oz soda
5 cans pepsi	4 cans pepsi
1/4 cup grape juice	1/2 cup grape juice
32 oz OJ	16 oz OJ
1/4 cup tomato juice	1/2 cup tomato juice
1/4 cup apple juice	1/2 cup apple juice
8 oz koolaid	12 oz koolaid
8 oz lemonade	12 oz koolaid
8 oz lemonade	12 oz koolaid
Condiments	
Reported Portion in Interview Recall	Closest Portion Available in IMM recall
1/2 tsp butter	1 tsp butter
1/2 Tbsp salsa	1/4 cup salsa
1 Tbsp salsa	1/4 cup salsa
1/2 Tbsp dressing	1 Tbsp dressing
1 tsp dressing	1 Tbsp dressing
1 tsp dressing	1 Tbsp dressing
12 t powedered creamer	4 tsp powedered creamer
6 Tbsp powdered creamer	4 tsp powedered creamer
2 Tbsp gravy	2 oz gravy
1 tsp mayo	1/2 Tbsp
1 tsp mayo	1/2 Tbsp
1/2 tsp jam	1 Tbsp jam

Table 3. Frequency modified fat varieties of foods were chosen.

Food item	Frequency of consumption
Whole milk	19
2% milk	18
1% milk	8
Skim milk	3
Regular ice cream	16
Light ice cream	1
Frozen yogurt	1
Regular sour cream	7
Light sour cream	2
Fat free sour cream	0
Regular mayo	17
Light mayo	1
Fat free mayo	0
Ranch	10
Light ranch	0
Fat free ranch	0
French	1
Light French	0
Fat free French	0
Italian	6
Light Italian	3
Fat fee Italian	0

Table 4. Foods rarely chosen by participants.

Foods chosen by 0 participants	Foods chosen by 1 participant
cream soup	chili
chicken sandwich	vegetable soup
pot pie	tomato soup
turkey	bacon
onion rings	chicken leg
dinner roll	meatloaf
biscuit	black beans
potato salad	broccoli
regular cottage cheese	canned Peaches
cauliflower	fresh Peaches
peas	low-fat cottage cheese
applesauce	light ice cream
pineapple	frozen yogurt
canned pears	pudding
light popcorn	fat free popcorn
wine cooler	tomato juice
shot (liquor)	wine
gravy	shredded yellow cheese
fat free sour cream	guacamole
light mayo	French
fat free mayo	
light ranch	
fat free ranch	
fat free Italian	

CHAPTER 5: Discussion

Since an IMM breakfast recall had been previously developed and tested (Lowe, 2001), this research focused on developing the lunch, supper and snacks component of the food recall. Overall results indicate that when portion sizes were reported, the IMM recall could be used to make inferences about dietary intakes by groups of individuals. Similar to the limitation of all single 24-hour recalls, the IMM recall may not accurately classify individuals above or below set cut-off points. In addition to the discussion generated in Chapter 3, related to development, and Chapter 4, related to the validation of the IMM dietary recall, there are additional points of discussion.

The pilot testing performed by CSU whereby a breakfast IMM recall to assess fat and fiber was developed and evaluated was especially helpful in providing the ground-work for this project. In the breakfast recall study, 85 low-income, low-literate, Caucasian and Hispanic participants completed a pencil/paper breakfast recall and an IMM breakfast recall. Subjects were randomized as to which recall method was completed first and randomized to complete either an IMM portion version(IMMp) or IMM no portion version(IMMnp). The type of recall had a significant effect with mean fat (IMM= 21.43; pencil/paper= 7.73 grams) and mean fiber (IMM= 4.14 grams; pencil/paper= 2.05 grams) values significantly higher ($p<0.0001$) for the IMM recalls than for the pencil/paper recalls. There were no significant differences found in the mean fat and fiber values between the IMMp and the IMMnp (p=0.571 for fat; p=0.2264 for fiber) (Lowe, 2001).

The findings of this study differ from results of the breakfast recall. The comparative gold standard in the breakfast recall was a pencil/paper recall whereas an interview-administered recall was used for the gold standard in this study. These findings reveal no significant method effect was found between the IMM recall and the interview-administered recall (except FIAS for vitamin C, p=0.025). It can be argued that the trained interview was able to probe and elicit more accurate reports of eating behavior than the pencil/paper method. Hence, the interview-administered recall was truly a superior gold standard, which improved the accuracy of validity testing. Additionally, the breakfast recall revealed no significant differences when standard portion sizes were used, while this study found significant differences when standardized portion sizes were used. The standardized portions were based on Bowes & Church in the breakfast recall, while CSFII data were used in this study (Pennington, 1998; Smicklas-Wright et al.). The CSFII is a more accurate report of portion sizes commonly consumed per eating occasion. Even though six significant differences were found in this study with the use of standardized portion sizes, fat and fiber were not significantly different, which supports findings from the breakfast recall.

During testing some subjects appeared to be exploring all the different links, instead of actually trying to enter the foods they had eaten. This is especially true of the eight subjects which were eliminated from the survey based on implausible intakes of >4,200 kcal for men or >3,500 kcal for women. This is of concern because in the future the IMM food recall may be used to evaluate changes in food behavior or determine eligibility for food assistance. Providing an option for new users to practice using the program prior to recording choices in the log-file may allow users to explore links and ease curiosity before entering actual food choices.

It was clear that some individuals were more concerned with receiving their cash incentive than using the IMM recall to accurately enter their foods. It is difficult to determine how this affected the quality of data obtained. However, it is probable that the IMM food recall becomes easier with repeated use. Since many low-literate, low-income persons are enrolled in food assistance programs for an extended length of time, repeated use of the IMM food recall may improve accuracy of entering food intake. Furthermore, if eligibility criteria or food coupons are awarded based on results of foods entered in the IMM recall, this may increase motivation to enter foods accurately.

The primary limitation of this study design, similar to all self-report diet validation studies, is the lack of a true gold standard. It is well known that subjects underreport both energy and protein intake with 24-hour dietary recalls when compared to doubly labeled water and urinary nitrogen (Hill & Davies, 2001; Kaczkowski et al., 2000; Kipnis et al., 2003; Kroke et al., 1999; Schatzkin et al., 2003; Subar et al., 2003; Trabulsi & Schoeller, 2001). However, the only validation alternatives include nutrient biomarkers or actual observation of participants' food intake. Biomarker measurements are expensive and feasible biomarkers do not exist for several important nutrients (Willett, 1998). Furthermore, observing actual intake over a 24-hour period is obtrusive, and the presence and attention of the observer may impact consumption patterns and accuracy of recall. Given these problems, the most practical alternative, a 24-hour recall obtained via a trained interview, was used to validate the IMM recall.

The IMM format forces a certain level of standardization that may result in obtaining less accurate information. The open-ended format of a 24-hour recall is forfeited when using an IMM format, which cannot accommodate an unlimited level of specificity regarding food choice. Another potential challenge is use of discrete portions to represent food items in the IMM dietary recall system. However, after analyzing the accuracy of foods and portion sizes reported in the IMM recall as compared to the interview-administered recall, this problem appears to be negligible. Through the use of both local food choice information and national data on food choice and portion sizes, the food options in the IMM dietary recall appear to accurately represent the intakes of the target population.

Although results indicate the IMM recall could be used to make inferences about dietary intakes by groups of individuals, it was no surprise that the IMM recall may not accurately classify individuals above or below set cut-off points. It is recognized that multiple days of assessment are needed to attain a level of accuracy appropriate for classifying individuals (Willett, 1998). However, the expense involved in providing trained personnel to obtain accurate food intake information over several days is a limiting factor. If used to collect information over multiple days, the IMM recall could potentially provide information accurate at an individual level, yet cost less than a trained interviewer.

The time invested in developing the IMM recall based on previous supporting research findings, as well as formative evaluation, proved to be extremely beneficial. The statistical findings support previous research with traditional 24-hour recalls, in that the IMM recall can be used for assessing food intake for groups of individuals. Findings emphasize that the use of IMM technologies is a feasible option for assessing diet. Additionally, the IMM recall has the ability to address many of the limitations of traditional forms of written and interview-administered diet assessment methods. This is the only known research that has studied the validity of an IMM recall generating a comprehensive nutrient profile. Based on these results, further exploration and development of IMM based dietary assessment is strongly recommended.

CHAPTER 6: Conclusions, Future Research & Application

Conclusions

The overall goals of this research were successfully accomplished including the development and validation of an IMM dietary recall for a low-income, low-literate, English- and Spanish-speaking adult population. As detailed below, of the four research hypotheses two were accepted and two were rejected.

HYPOTHESIS

1. **Accepted:** There will be no significant difference within-subjects for those who complete the IMM recall first, versus those participants who complete the 24-hour recall with a trained interviewer first. Order of administration will not affect food recall data and nutrient analysis.
2. **Accepted:** There will be no significant difference in the mean difference scores of all nutrients between the IMM recall and the trained interviewer recall. The type of recall will not affect the foods reported.
3. **Rejected:** There will be no significant differences in the mean difference scores of all nutrients when reported portion sizes versus standardized portion sizes are analyzed.

4. **Rejected:** There will be no significant differences between preference for the IMM dietary recall and the interviewer or pencil/paper method for reporting dietary intake.

Hypothesis #1 is accepted because findings revealed no significant period effects, hence no difference when the IMM recall or the interview-administered recall was performed first. Hypothesis #2 is accepted because for the majority of nutrients, the method of recall (IMM or interview-administered) did not affect the means. The only significant method effect was between the IMM recall and interview-administered recall using FIAS for vitamin C ($p=0.025$). In addition to comparing means, unadjusted correlation coefficients were calculated to measure the strength of relation between the IMM and interview-administered recalls. The unadjusted correlations between the IMM recalls and interview-administered recalls analyzed using both FIAS and ERS were generally around 0.6. Correlation coefficients for these types of studies are normally in the range of 0.4 to 0.7 (Thompson & Subar, 2001; Willett, 1998). These combined results indicate the IMM recall would generally be considered satisfactory for making inferences about intakes by groups of individuals in epidemiologic research; however such data cannot accurately classify individuals as above or below set cut-off points. This finding is consistent with the limitations of a single 24-hour diet recall. Most individual's diets vary from day to day, and therefore a single 24-hour recall may not accurately characterize an individual's usual diet. For this reason, the principal use of single 24-hour recall is to describe the average dietary intake of a group.

Energy adjusted correlations, using the residual method, were also determined (Willett, 1998). An energy-adjusted correlation is important to control measurement error in the dietary assessment instrument and used if researchers are interested in dietary composition as related to a disease risk. In this study, after adjusting for energy, correlation coefficients consistently decreased. This can be explained by the fact that energy between the IMM recalls and interview-administered recalls were highly correlated prior to adjustment (0.74 for both ERS and FIAS). Since energy adjusted nutrients provide a measure of nutrient intake uncorrelated with total energy, the energy-adjusted nutrients consequently decreased. Our data supports those findings by Schatzkin, in that energy adjusted correlations decreased in a population comprised primarily of women (Schatzkin et al., 2003).

Hypothesis #3 is rejected because when reported portion sizes were replaced with standardized portion sizes ANOVA tests revealed significant differences for six dietary constituents including: carbohydrates (p=0.0069), vitamin A (p=0.0098), vitamin C (p=0.0020), calcium (p=0.0109), dairy servings (p=.0105), and other servings (p=0.0319). The following three nutrients approached significance: protein (p=0.0533), vitamin B6 (p=0.0644), and alcohol (p=0.0904). Furthermore, when standardized portions were substituted for reported sizes in the IMM dietary recall, correlation values consistently dropped. These findings indicate that using a standardized portion sizes is not appropriate in the IMM recall.

Hypothesis #4 is rejected because when polled in the opinion survey the majority of participants, 53%, preferred to use the touch-screen computerized recall to report food intake; 39% preferred an interviewer, and 8% preferred the pencil/paper method. The favorable feedback received from the participants regarding use of a computer and IMM technology to assess diet indicates further development and improvements of the IMM recall is worthwhile.

Overall, the IMM recall is valid for assessing dietary intake by groups of individuals. Using standardized portion sizes compromised the data, and therefore portion sizes should be queried. After incorporating the suggestions resulting from this research, it is probable that the accuracy of food reporting via the IMM method will improve and correlations between the IMM recall and gold standard will increase. In light of the exploratory nature of this project and novel approach at assessing diet, overall statistical and qualitative findings were strongly supportive.

Future Research

There are a number of potential future research possibilities arising from this project. The first step should include combining the breakfast component with the lunch, supper, and snacks component. At this time the suggested recommendations resulting from both the breakfast pilot study as well as this validation study should be incorporated. The complete 24-hour recall should then be validated again within the target population using a similar study design. Analysis of data should account for nutrient profile comparisons and for foods matched between the two methods. Accuracy of reported food consumption in terms of matches, intrusions, and omissions between the IMM dietary recall and the interview-administered recall is another important method for assessing validity.

A future study may also include testing the IMM recall within the EFNEP protocol with participants completing a pencil-and-paper entry and exit 24-hour recall. The participants would complete both a pencil-and-paper and IMM dietary recall at entry and exit. Statistical analysis should be preformed to determine if the IMM recall could detect changes comparable to the pencil-and-paper recall. In the future, the ability to interface the IMM generated nutrient profile with the ERS will be crucial in meeting the data requirement needs of EFNEP.

Understanding the cognitive process involved when respondents answer survey questions is an important step in both the development and improvement of questionnaires. Using the cognitive model as a framework, it is possible to identify sources of error in questionnaires, and subsequently make improvements in the instruments. Although identifying respondent error through application of the cognitive model adds significantly to the amount of preliminary pilot work an instrument requires during the developmental phase, researchers utilizing this technique has demonstrated improvements in questionnaires (Durante & Ainsworth, 1996; Subar et al., 1995; Thompson et al., 2002). As the IMM recall enters into the next phase of development, this may be the perfect opportunity to explore and understand the cognitive processes underlying the question-answering cycle as users navigate through the IMM dietary recall.

Eliminating the step in which the log-file has to be manually imported into Access is needed in order to provide the user and educator with instant diet analysis. Then the possibility of linking the diet analysis output with computer-tailored personalized messages should be explored, developed and tested.

There is also the potential of expanding the IMM recall for use in other populations and multiple ethnic groups. The economic, social, cultural, and geographical factors related to food choice in an expanded audience would need to be considered. In addition to expanding the food recall to include more diverse food choices, there is also the potential of developing a similar program into a FFQ format.

Application

The IMM dietary recall can directly link food choice, portion sizes, and cooking methods to generate a nutrient profile. Instant data entry can save staff time and resources and allow more time to be spent on nutrition education instead of dietary analysis. Instant data analysis also eliminates error, estimation, and biases from having a third party enter the data. Minimizing measurement error is a key element in successful dietary assessments. IMM technology can allow dietary assessment in those underserved populations, which are commonly excluded from research studies due to the inability to read and/or write English, including low-literate and multiple ethnic group populations. Furthermore, the use of computer-tailored nutrition education has exploded in recent years. There is great potential to interface results from an IMM generated nutrient profile with specific nutrition education messages aimed at improving food choice and dietary patterns.

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APPENDICES

Appendix A: Food Determination Spreadsheet

Food Determination Spreadsheet						
		% HHANES (1)	%EFNEP for lunch or dinner (2)	Both >2% (3)	One >2% (4)	Include Food (5)
Primary Group	**Food Item**					
Soup						
	Chili	3.2	2.6%	*		Y
	Beef Stew		5.2%		*	Y
	Broth based soup (Chix noodle)	16.3	7.3%	*		Y
	Cream based soup (Cr Chix)		1.0%		*	Y
	Sopa seca "rice soup"					
	Ramen Noodles		3.7%		*	Y
	Vegetable soup	3.3	3.7%	*		Y
	Tomato soup		3.7%	*		Y
Protein Sources/Sandwich						
	hamburger	25.4	17.3%	*		Y
	lunchmeat, ham	16.5	12.6%	*		Y
	hotdog		5.8%	*		Y
	chix, egg, tuna salad		11.0%		*	Y
	pnbutter	4.6	6.3%	*		Y
	peanuts		1.6%	*		Y
	cheese	25.4	6.3%	*		Y
	bacon (BLT)	7.2	2.1%	*		Y
	Beef steak, roast	22.3	16.2%	*		Y
	Meatloaf		6.3%		*	Y
	Fried Chix	9.7	11.0%	*		Y
	Chix	13.0	18.3%	*		Y
	Turkey		5.8%	*		Y
	Pork, chop & roast	14.3	1.0%		*	Y
	Fish, all	3.4	7.9%	*		Y
	Eggs	39.5	2.6%	*		Y
	Shellfish	1.5	0.0%			N
	Liver	1.4	0.0%			N
	Tongue, gizzard, game	3.1	0.0%		*	N
	Sausage	3.5	0.0%	*		N
	Tongue, gizzard, game	3.1	0.0%		*	N
	Sausage	3.5	0.0%	*		N
Casserole/Mixed Food/Mexican Food						
	Spaghetti	1.6	3.1%		*	Y
	Lasagna		3.6%		*	Y
	Pizza	3.9	12.0%	*		Y
	Taco	1.5	6.3%		*	Y
	Enchiladas		2.6%		*	Y
	Tamales		0.0%			N
	Burrito		6.8%		*	Y
	Pot pie		2.1%		*	Y
	Mixed dish with chicken	1.1	0.0%			N
	Mixed dish with beef (beef, veg, noo	7.6	3.1%	*		Y

		% HHANES (1)	%EFNEP for lunch or dinner (2)	Both >2% (3)	One >2% (4)	Include Food (5)
	Stir Fry		1.6%			N
	Tuna noodle casserole, tuna	3.8	2.6%	*		Y
	mixed dishes with cheese (mac-n-ch	5.6	4.2%		*	Y
Breakfast items						
	cereal	12.5	4.2%	*		N
	doughnuts, pastries, sweet rolls	7.4	0.0%		*	N
	cooked cereal	3.3	0.5%		*	N
	pancakes, waffles, French toast	2.5	0.0%		*	N
Salads						
	Green Side Salad & salad veg.	29.1	38.7%	*		Y
	Green Chef Salad		1.6%			N
	Taco salad		1.6%			N
	coleslaw	3.5	1.6%		*	Y
	pasta salad		4.2%		*	Y
	potato salad		2.1%		*	Y
	cottage cheese	2.4	4.2%	*		Y
Rice, Beans, Potatoes, Chips						
	Rice, rice dishes	24.0	20.9%	*		Y
	Beans, pinto, navy, black, refried	37.5	11.5%	*		Y
	Fried Potato, French fries	24.1	13.1%	*		Y
	Mashed Potato	14.3	10.5%	*		Y
	Baked Potato		14.1%	*		Y
	Potato Chips, corn chips, cornpuffs	14.6	25.1%	*		Y
	Onion Rings		2.6%		*	Y
Bread, Roll, Crackers						
	White Bread	54.1	20.4%	*		Y
	Wheat Bread		20.4%	*		Y
	Dinner Roll		0.0%		*	Y
	Crackers		14.1%	*		Y
	Corn Tortilla	29.4	1.0%		*	Y
	Flour Tortilla	28.9	3.1%	*		Y
	Biscuit	2.9	7.9%	*		Y
	Muffin					N
	Cornbread	1.7	0.0%			N
	Hot dog bun		0.0%			Y
	French/garlic bread		5.8%		*	Y
Vegetables						
	Tomato(& tomato juice)	25.1	3.1%	*		Y
	Corn	6.4	11.0%	*		Y
	Green beans	3.0	19.4%	*		Y
	mixed vegetables	1.9	4.2%		*	Y
	carrots	7.8	7.9%	*		Y
	peas	2.4	4.7%	*		Y
	cauliflower	0.6	2.6%		*	Y

		% HHANES (1)	%EFNEP for lunch or dinner (2)	Both >2% (3)	One >2% (4)	Include Food (5)
	broccoli	2.1	10.0%	*		Y
	avacado	5.3	0.0%		*	Y
	plantains	2.0	0.0%		*	N
	green peppers	3.3	2.6%	*		Y
	onions	10.3	1.6%		*	Y
	summer squash	2.6	0.0%		*	N
	spinach	0.6	1.6%			N
Fruit						
	apple	8.5	7.3%	*		Y
	applesauce		3.1%	*		Y
	banana	7.7	4.2%	*		Y
	fruit cocktail	1.3	5.2%		*	Y
	peaches	3.3	2.6%	*		Y
	grapes	2.1	1.6%		*	Y
	orange, tangerine	5.7	0.5%		*	Y
	watermelon	1.8	1.0%			Y
	cantaloupe	1.0	1.0%			Y
	pineapple	1.0	2.1%		*	Y
	papaya	1.5	0.0%			N
	pears	1.4	2.1%		*	Y
	plums	1.4	0.0%			N
	strawberries	0.3	1.0%			Y
Dessert						
	Desserts generic		31.9%		*	Y
	Chocolate candy	4.0			*	Y
	Non-chocolate candy	3.6			*	Y
	Cookies	17.0			*	Y
	Cake				*	Y
	Brownie					Y
	Ice Cream, frozen dessert	6.7	1.0%		*	Y
	Yogurt	0.7	2.1%		*	Y
	Pie	2.2			*	Y
	Pudding	1.2	2.1%		*	Y
	Jell-O	1.3	0.5%			N
	Mexican pan dulce	2.7	0.0%		*	N
Beverages						
	Milk (all types)	66.7	59.7%	*		Y
	Juice (all types)		27.7%		*	
	Orange juice	19.9		*		Y
	Grapefruit juice				*	
	Apple juice	3.6			*	Y
	Grape juice				*	Y
	Tomato Juice (& tomato	25.1			*	Y
	Tea	49.4	24.1%	*		Y
	Coffee		7.9%	*		Y
	Soda	54.1	45.5%	*		Y

		% HHANES (1)	%EFNEP for lunch or dinner (2)	Both >2% (3)	One >2% (4)	Include Food (5)
	Fruit drink, punch, Kool-Aid	21.6	13.6%	*		Y
	Lemonade		5.8%		*	Y
	alcoholic beverages	6.0	2.1%		*	Y
Others						
	sugar	39.3	8.9%	*		Y
	butter	28.9	24.1%	*		Y
	margarine		0.0%		*	Y
	lard	3.6	0.0%		*	Y
	cooking spray		0.0%			Y
	salsa, ketchup	29.3	5.8%	*		Y
	mustard, other non-tomato sauces	8.2	0.0%		*	N
	non dairy creamer	6.2	0.0%		*	Y
	chili pepper, sauce	4.3	0.0%		*	Y
	jelly, jam, honey	4.0	0.0%		*	Y
	syrup, molasses	3.1	0.0%		*	Y
	sour cream, dip	3.0	5.2%	*		Y
	pickles	3.0	0.0%	*		N
	guacamole		0.0%		*	Y
	Mayo	20.4	3.7%	*		Y
	Salad dressing		19.4%	*		Y
	Cooking oil	8.5	0.0%		*	Y
	Salad oil		0.0%		*	Y
	gravy	6.6	12.0%	*		Y
	cream, 1/2 & 1/2	2.3	1.0%		*	Y

(1) Data obtained from 1982-1984 Hispanics Health and Nutrition Examination Survey.
The shaded areas represent foods that were grouped together in the HHANES report.
(2) Data obtained from 191 24-hour written dietary recalls of EFNEP participants.
The percent represents the number of people consuming the food at lunch or dinner.
(3) Indicates the food item was reported by >2% of the subjects in both surveys
(4) Indicates the food item was reported by >2% of the subjects in one of the surveys
(5) Y indicates 'yes' food is included in the IMM recall; reported by >2% of the subjects in one or both surveys (with a few exceptions). N indicates 'no' food is not included in the IMM recall.

Appendix B: Nutrient Database

Nutrient	Food ID#1(1)	Food ID#2(5)	Reference portion size	Multipliers(6)	Multiplier for standardized portion size (7)	Source of information for standardized portion size	Freqency food reported by subject (10)	Energy	Protein	Fat	CHO	DFIB	Alcohol	Vit A	Vit C	Ca	Iron	Vit B6	FOL	SFA	Chol	Meat	Dairy	Veg	Bread	Fruit	Other
Units								kcal	g	g	g	g	g	RE	mg	mg	mg	mg	mcg	g	mg	serv	serv	serv	serv	serv	serv
chili	ERS 366 (2)	USDA 22904	1 cup=254g	"1, 1.5, 2, 2.5"	1.13	DHQ (8)	1	321	22.4	14.1	27.1	7.4	0	119	21	60	3.8	0.35	72.65	2.65	30.52	1	0	1.5	0	0	0
beef stew	ERS 94	USDA 22905	1 cup=252g	"1, 1.5, 2, 2.5"	1.5	DHQ	2	176	17.2	3.7	18	2	0	501	12	25	2.6	0.34	20.67	4.17	29.7	1	0	2	0	0	0
broth soup	ERS 1160	USDA 06419*	1 cup=241g	"1, 1.5, 2, 2.5"	1.53	CSFII (9)	2	75	4.1	2.5	9.4	0.7	0	72	0	17	0.8	0.03	21.69	0.651	7.23	0.25	0	0	0.5	0	0
cream soup	ERS 1166	USDA 06243*	1 cup=248g	"1, 1.5, 2, 2.5"	1.49	CSFII	0	203	6.1	13.6	15	0.5	0	37	2	179	0.6	0.06	9.92	5.134	19.84	0	0.67	1	0	0	3
ramen noodles	ERS 1180	USDA 6581	1 cup=244g	"1, 1.5, 2, 2.5"	1.51	CSFII	3	158	5.2	1.9	29.6	3	0	238	0	19	1.9	0.07		0.55		0	0	0	1.5	0	0
vegetable soup	ERS 1199	USDA 06468*	1 cup=241g	"1, 1.5, 2, 2.5"	1.53	CSFII	1	72	2.1	1.9	12	0.5	0	301	1	22	1.1	0.06	9.64	0.289	0	0	0	1	0	0	0
tomato soup	ERS 1196	USDA 06559*	1 cup=244g	"1, 1.5, 2, 2.5"	1.51	CSFII	1	85	2.1	1.9	16.6	0.5	0	68	66	12	1.8	0.11	14.64	0.366	0	0	0	1	0	0	0.33
3 oz hamburger	ERS 641	USDA 21202	3 oz	"1, 2, 3, 4"	1	DHQ	9	342	19.73	16.2	27.9	0.75	0	0	0	60	3.08	0.2	49.68	6.34	56.45	0.75	0	0	1.5	0	3
5 oz hamburger	ERS 641	USDA 21202	5 oz	"1, 2, 3, 4"	0.6	DHQ	2	570	32.88	27	46.5	1.25	0	0	0	100	5.12	0.34	82.14	10.56	94.09	1.25	0	0	2.5	0	5
white cheese	ERS 302	USDA 01042*	1 oz=21g	"1, 2, 3, 4"	1.52	CSFII	3	79	4.7	6.6	0.3	0	0	61	0	129	0.1	0.27	1.68	4.136	19.74	0	0.4	0	0	0	1.5
yellow cheese	ERS 302	USDA 01042*	1 oz=21g	"1, 2, 3, 4"	1.52	CSFII	14	79	4.7	6.6	0.3	0	0	61	0	129	0.1	0.01	1.68	4.136	19.74	0	0.4	0	0	0	1.5
ham	ERS 635	USDA 7212	1 oz=28g	"1, 2, 3, 4"	2.39	CSFII	8	45	5.1	2.4	0.6	0	0	0	8	2	0.3	0.11		0.98		0.33	0	0	0	0	0
chicken	USDA 07251 (3)	USDA 07251*	1 oz=28g	"1, 2, 3, 4"	2.39	CSFII	0	35.8	4.76	1.568	0.644	0	0	0	0	4.76	0.442			0.407	16.52	0.33	0	0	0	0	0
bologna	ERS 132	USDA 07201*	2slice=28g	"1, 2, 3, 4"	2.39	CSFII	6	44	1.7	4	0.1	0	0	0	3	2	0.2	0.02	3.64	3.598	19.6	0.3	0	0	0	0	0.66
turkey	USDA 07256	USDA 07256*	1 oz=28g	"1, 2, 3, 4"	2.39	CSFII	10	27.44	4.62	0.532	1.036	0	0	0	0	1.68	0.277			0.131	10.64	0.33	0	0	0	0	0
salami	ERS 1065	USDA 7068	1 slice=23g	"1, 2, 3, 4"	2.91	CSFII	2	58	3.2	4.6	0.5	0	0	0	3	3	0.6	0.05	0.46	2.07	14.95	0.2	0	0	0	0	0.67
chicken salad	ERS 1052	B&C	1 oz=30g	"1, 2, 3, 4"	4	DHQ	4	69.5	4.92	5.32	0.42	0.17	0	8	0.5	6.17	0.27	0.08		0.75	12.5	0.33	0	0	0	0	0.33
egg salad	ERS 499		1 oz=28g	"1, 2, 3, 4"	3.6	DHQ	2	88.25	2.54	8.41	0.44	0	0	39.63	0	11.25	0.28	0.07				0.17	0	0.03	0	0	1.5
tuna salad	ERS 580	USDA 15128	1 oz=30g	"1, 2, 3, 4"	2.17	CSFII	3	45	4.84	1.57	2.79	0.14	0	7.86	0.71	4.86	3	0.02	2.34	0.791	3.8	0.29	0	0	0	0	0.29
hot dog	ERS 650	USDA 21118	1 hot dog on bun=85g	"1, 2, 3, 4"	1.5	DHQ	5	263	8.4	15.4	22.4	0.8	0	0	12	45	1.6	0.08	48	5.109	44.1	0.33	0	0	2	0	1
chicken sandwhich	B&C (4)	B&C	1 sandwich on bun = 189g	"1, 2, 3, 4"	1		4	310	27	8	35	2	0		6	100	2.7			1.5	65	1	0	0	2	0	1
sub sandwich	ERS 1088	USDA 21124	3 in sandwich=99g	"1, 2, 3, 4"	2		11	560	20.9	18.65	17.1	0.65	0	47	9.5	122	1.55	0.11	54.75	4.155	22.255	0.5	0.375	0.25	1.5	0	1.75
peanut butter	ERS 877	USDA 16098*	1 tablespoon=16g	"1, 2, 3, 4"	1.69	CSFII	7	94	3.9	8	3.3	1	0	0	0	5	0.3	0.06	11.84	1.65	0	0.25	0	0	0	0	1
bacon	ERS 16	USDA 10124	1 slice=8g	"1, 2, 3, 4"	2.5	CSFII	1	46	2.4	3.9	0.1	0	0	0	3	1	1	0.02	0.399	1.34	6.783	0.16	0	0	0	0	0.33
spaghetti	ERS 1205	USDA 22518	1 cup=248g	"1, 1.5, 2, 2.5"	1.76	CSFII	7	306	17.9	11.6	32.9	3.4	0	137	25	116	3.7	0.38		4.74	26.35	1	0	0.5	1.5	0	0
lasagna	ERS 719	USDA 22673	1 avg=206g	"1, 2, 3, 4"	1.81	DHQ	5	327	19	16.38	44.59	3.64	0	172.9	16.9	286	2.9	0.286		7.64	44.63	0.87	0.87	1.3	1.3	0	1.625
pizza	ERS 930	USDA 21050	1 slice=79g	"1, 2, 3, 4"	2.14	CSFII	9	193	8.7	9.6	18.1	1.4	0	52	15	135	1.5	0.11	32.39	1.535	20.54	0.15	0.5	0.5	1	0	1.5
taco	ERS 1244	USDA 21082	1 taco=83g	"1, 2, 3, 4"	1.5	DHQ	11	179	11	9.7	12.5	1.8	0	52	5	89	1.3	0.16	33.18	5.57	27.65	0.5	0.25	1	1	0	0.5
enchiladas	ERS 519/521/522	USDA 21075	1 enchilada =117g	"1, 2, 3, 4"	1.5	DHQ	3	225	9.7	11.1	22.83	4	0	178.83	13	158.67	1.6	0.253	44.66	5.97	26.61	0.5367	0.43	0.33	1	0	1.33
burrito	ERS 174/176	USDA 21064	1 burrito=140g	"1, 2, 3, 4"	1.5	DHQ	15	365	26.1	18.2	25.35	1.45	0	106.5	2	163	2.6	0.225	57.27	5.434	94.11	1	0.5	0.5	1	0	0.5
mixed dish with beef	ERS 1395	B&C	1 cup=144g	"1, 1.5, 2, 2.5"	1.5	DHQ	4	358	17.8	25.6	13.9	1.7	0	73	4	110	2	0.21		4	50	1	0.33	0.25	0	0	2.33
macaroni & cheese	ERS 1483	USDA 22247	1/2 cup=95.5	"1, 2, 3, 4"	2.55	CSFII	2	198.5	5.3	9.5	22.75	1	0	105.5	0	74.5	1	0		3	7.56	0	0.25	0	0.75	0	2.125
tuna noodle casserole	ERS 1435	B&C	1 cup=250g	"1, 1.5, 2, 2.5"	0.98	CSFII	5	289	16	11	30.9	0	0	86	0	85	1.5	0.06		3	20	0.33	0.2	0	1	0	1.33
pot pie	ERS 77	USDA 22906	.5 pie=126g	"1, 2, 3, 4"	2	DHQ	0	300	9.85	19.15	21.85	1.3	0	247	4.5	13.5	1.9	0.165	25.66	5.99	25.56	0.5	0	0.5	0.5	0	2.16
roast beef	ERS 84	USDA 13548	3 oz=84g	"1, 2, 3, 4"	1.2	CSFII	3	222	21.6	14.7	0	0	0	0	0	6	2.1	0.27	9.35	4.31	85.85	1	0	0	0	0	0
beef steak	ERS 86	USDA 23002	3 oz=84g	"1, 2, 3, 4"	1.65	CSFII	13	216	21.3	14.1	0	0	0	0	0	6	2.1	0.24	5.1	6.15	51.9	1	0	0	0	0	0
meatloaf	ERS 758	B&C	1 slice=108gm	"1, 2, 3, 4"	1.77	CSFII	1	229	17.9	13.9	6.5	0	0	17	1	44	2	0.15		4.86	89.1	1	0	0.5	0	0	0
pork chop	ERS 953	USDA 10053	3 oz=84g	"1, 2, 3, 4"	1	CSFII	7	288	19.8	22.8	0	0	0	3	0	6	0.6	0.33	2.55	4.726	69.7	1	0	0	0	0	0
leg	ERS 345	USDA 5078	1 drumstick=56g	"1, 2, 3, 4"	1.7	CSFII	1	130	14.4	7.6	0	0	0	22	0	6	0.8	0.18	3.92	2.08	52.25	0.66	0	0	0	0	0
wing	B&C	B&C	1 wing=34g	"1, 2, 3, 4"	2.8	CSFII	4			6.6	0	0	0	16	0	5	0.43	0.14	1	1.9	29	0.5	0	0	0	0	0
breast	ERS 333	USDA 5060	3 oz=84g	"1, 2, 3, 4"	1.13	CSFII	8	186	26.7	7.5	1.5	0	0	12	0	12	0.9	0.48	2.32	1.27	48.72	1	0	0	0	0	0
turkey	ERS 1279/1287	USDA 5202	3 oz=84g	"1, 2, 3, 4"	1.1	CSFII	0	56	8.15	1.45	0	0	0	0	0	7	0.55	0.125	8	0.87	98	1	0	0	0	0	0
fish	ERS 537	USDA 15016	3 oz=84g	"1, 2, 3, 4"	1.31	CSFII	7	102	17.4	3	0.3	0	0	45	3	18	0.3	0.21	7.79	0.163	53.3	1	0	0	0	0	0
eggs	ERS 505	USDA 01131*	1 egg=50g	"1, 2, 3, 4"	0.84	CSFII	10	74	6.2	5	0.6	0	0	95	0	24	0.7	0.06	17.5	1.544	211.5	0.5	0	0	0	0	0
rice	ERS 1042	USDA 20055	1/2 cup=83g	"1, 2, 3, 4"	1.81	CSFII	16	89	1.8	0	19.8	0.65	0	0	0	3	0.65	0.01	0.87	0.034	0	0	0	0	1	0	0
rice dish	ERS 1033	B&C	1/2 cup=121.5	"1, 2, 3, 4"	1.23	CSFII	4	104	2.2	1.7	20.35	1.6	0	52	20	33	1.5	0.125	9.35	0.055	0	0	0	0.5	1	0	0
pinto beans	ERS 49	USDA 16343	1/4 cup=43g	"1, 2, 3, 4"	3.08	CSFII	5	48.75	3	0.175	9.075	43.5	0	0	0.75	16.25	0.725	0.045	61.125	0.04	0	0.125	0	0.25	0	0	0
navy beans	ERS 57	USDA 16338	1/4 cup=44g	"1, 2, 3, 4"	3.02	CSFII	2	60.5	4.225	0.15	10.925	2.3	0	0	0	39.25	1.6	0.04	63.5	0.067	0	0.125	0	0.25	0	0	0
black beans	ERS 40	USDA 16315*	1/4 cup=42g	"1, 2, 3, 4"	3.17	CSFII	1	113.5	7.6	0.25	10.2	3.75	0	0.5	0	11.5	0.9	0.3	32.04	0.03	0	0.125	0	0.25	0	0	0.75
refried beans	ERS 51	USDA 16103	1/4 cup=63g	"1, 2, 3, 4"	2.11	CSFII	7	67.5	3.95	0.675	11.7	2.75	0	0	0	29.5	1.125	0.0975	7.9	0.34	5.74	0.125	0	0.25	0	0	0.125
baked potato	ERS 973	USDA 11674	4 oz=122g	"1, 2, 3, 4"	0.98	CSFII	7	132	2.8	0.1	30.6	2.4	0	0	16	12	1.74	0.42	13.32	0.03	0	0	0	1	0	0	0
mashed potatoes	ERS 1379	USDA 11371*	1/2 cup=105g	"1, 2, 3, 4"	1.79	CSFII	4	112	2	4.5	17.5	2.1	0	21	6.5	27.5	0.25	0.24	8.4	1.08	2.1	0	0.1	1	0	0	1
french fries	ERS 595	USDA 21138	2.4 oz=68g	"1, 2, 3, 4"	1.22	CSFII	15	220	3	11.5	26.1	0.5	0	2	13	9	0.6	0.2	24.5	2.49	0	0	0	2	0	0	2.5
onion rings	ERS 841	USDA 21130	1/2 cup=48g	"1, 2, 3, 4"	1.73	CSFII	0	85	1.2	6.5	5.7	0.6	0	5	2	36	0.3	0.05	16.98	2.15	4.37	0	0	0.5	0	0	1.44

Nutrient	Food ID#1(1)	Food ID#2(5)	Reference portion size	Multipliers(6)	Multiplier for standardized portion size (7)	Source of information for standardized portion size	Freqency food reported by subject (10)	Energy	Protein	Fat	CHO	DFIB	Alcohol	Vit A	Vit C	Ca	Iron	Vit B6	FOL	SFA	Chol	Meat	Dairy	Veg	Bread	Fruit	Other
Units								kcal	g	g	g	g	g	RE	mg	mg	mg	mg	mcg	g	mg	serv	serv	serv	serv	serv	serv
potato chips	ERS 375	USDA 19411	1 ounce=28g	"1, 2, 3, 4"	1.39	CSFII	10	146	1.8	9.9	14.5	1.3	0	0	12	7	0.3	0.14	12.75	3.1	0	0	0	0	0	0	2.25
tortilla chips	ERS 376	USDA 19056	1 ounce=28g	"1, 2, 3, 4"	1.5	CSFII	12	146	2.2	7.5	17.9	1.6	0	13	0	45	0.18	0.08	2.835	1.423	0	0	0	0	0	0	4.16
pretzels	ERS 990	USDA 19047	1 ounce=28g	"1, 2, 3, 4"	2.57	DHQ	3	109	2.7	1.3	21.3	0.8	0	0	0	6	1.3	0.02	48.47	0.231	0	0	0	0	1	0	0
white bread	ERS 153	USDA 18069	1 slice=26g	"1, 2, 3, 4"	1.92	CSFII	38	69	2.1	0.9	12.8	0	0	0	0	30	0.8	0.01	23.75	0.132	0.25	0	0	0	1	0	0
wheat bread	ERS 154	USDA 18075	1 slice=26g	"1, 2, 3, 4"	1.92	CSFII	20	63	2.6	1.1	11.8	2	0	0	0	26	0.8	0.03	14	0.257	0	0	0	0	1	0	0
dinner roll	ERS 1511	USDA 18349	1 roll=35g	"1, 2, 3, 4"	1.66	CSFII	0	112	3	2.7	18.6	0.6	0	28	0	21	1	0.02	36.1	0.366	0	0	0	0	1	0	0
saltine crackers	ERS 442	USDA 18228*	6 crackers=18g	"1, 2, 3, 4"	1.44	CSFII	5	78	1.8	2.4	13.2	0.6	0	0	0	6	0.6	0	22.32	0.528	0	0	0	0	1.5	0	0.6
club crackers	ERS 440	USDA 18621	6 crackers=18g	"1, 2, 3, 4"	1.44	CSFII	10	108	0	6	12.6	0.6	0	0	0	30	0.6	0	2.19	0.144	0	0	0	0	1.5	0	1.2
flour tortilla	ERS 1276	USDA 18364	1 tortilla=30g	"1, 2, 3, 4"	2	CSFII	7	95	2.5	1.8	17.3	1.5	0	0	0	46	1.1	0.01	34.87	0.495	0	0	0	0	1	0	0
corn tortilla	ERS 1275	USDA 18363	1 tortilla=30g	"1, 2, 3, 4"	2	CSFII	18	67	2.2	1.1	12.8	1.6	0	0	0	42	0.6	0.09	32.319	0.095	0	0	0	0	1	0	0
biscuit	ERS 124	USDA 18009	l biscuit=30g	"1, 2, 3, 4"	2.03	CSFII	0	114	2.2	5.3	14	0.5	0	4	0	78	0.8	0.01	16.73	0.71	0.284	0	0	0	1	0	1.25
french or garlic bread	ERS 140	USDA 18029	1 slice=40g	"1, 2, 3, 4"	1.25	CSFII	6	134	3.5	5.1	18.3	0.8	0	46	0	40	1.1	0.02	46.55	0.315	0	0	0	0	1	0	1
lettuce salad	ERS 1054	USDA 11250	1 cup=74g	"1, 2, 3, 4"	1.8	CSFII	15	12	0.7	0.1	2.3	0.8	0	14	4	17	0.3	0.04	38.08	0	0	0	0	1	0	0	0
lettuce salad with vegetal	B&C	B&C	1 cup=207g	"1, 2, 3, 4"	0.46	CSFII	25	33	2.6	0.1	6.7	1	0	236	48	27	1.3	0.17	77	0	0	0	0	1	0	0	0
coleslaw	ERS 396	B&C	1/4 cup=46g	"1, 2, 3, 4"	2.22	CSFII	6	62.5	0.475	5.65	3.175	1	0	105.75	14	17	0.225	0.06	16	0.2	5	0	0	0.5	0	0	1.375
pasta salad	ERS 812	B&C	1/4 cup=44.3g	"1, 2, 3, 4"	3	DHQ	3	65.75	0.95	3.95	6.825	0.425	0	104.25	2.75	6.5	0.375	0.03		0.3	10.2	0	0	0.125	0.5	0	0.75
potato salad	ERS 1058	USDA 11414*	1/4 cup=62.5g	"1, 2, 3, 4"	3	DHQ	0	89.5	1.675	5.125	6.975	1.325	0	13	6.25	12	0.4	0.09	4.38	0.89	42.5	0	0	0.5	0	0	1.125
regular cottage cheese	ERS 430	USDA 01012*	1/4 cup=52.5g	"1, 2, 3, 4"	2.5	DHQ	0	54.25	6.55	2.375	1.4	0	0	25.25	0	61.5	0.075	0.035	6.3	1.5	7.88	0	0.125	0	0	0	0.5
low-fat cottage cheese	ERS 432	USDA 01016*	1/4 cup=57g	"1, 2, 3, 4"	2.5	DHQ	1	41	7	0.575	1.55	0	0	6.25	0	34.5	0.075	0.04	6.78	0.36	2.26	0	0.125	0	0	0	0.125
tomato	ERS 1270	USDA 11529	1/4 tomato=31g	"1, 2, 3, 4"	1.71	CSFII	26	6	0.275	0.075	1.325	0.4	0	34.75	5.5	2	0.15	0.015	4.6125	0.01	0	0	0	0.25	0	0	0
corn	ERS 423	USDA 11903	1 cup=169g	"0.5, 0.75, 1, 1.25"	0.6	CSFII	4	106	2.75	6.1	41.1	8	0	72	10	0	10	0.1	97.2	0.198	0	0	0	2	0	0	1.25
cauliflower	ERS 250	USDA 11136*	1 cup=124g	"0.5, 0.75, 1, 1.25"	0.38	DHQ	0	14	1.1	0.2	5.4	3	0	2	60.1	31	0.5	0.21	54.52	0.086	0	0	0	2	0	0	0
green beans	ERS 1510	USDA 11729*	1 cup=135g	"0.5, 0.75, 1, 1.25"	0.67	CSFII	6	13.5	0.8	0.1	6.1	2.6	0	47	6	35	1.2	0.5	43.2	0.03	0	0	0	2	0	0	0
mixed vegetables	ERS 1303	USDA 11581	1 cup=182g	"0.5, 0.75, 1, 1.25"	0.75	DHQ	7	33	1.3	0.4	12.9	5.6	0	925	7	38	1.2	0.15	33.97	0.07	0	0	0	2	0	0	0
carrots	ERS 1348	USDA 11125*	1 cup=156g	"0.5, 0.75, 1, 1.25"	0.46	CSFII	6	35	0.85	0.2	16.3	5.8	0	3830	4	48	1	0.38	21.84	0.054	0	0	0	2	0	0	0
peas	ERS 884	USDA 11305*	1 cup=160g	"0.5, 0.75, 1, 1.25"	0.54	CSFII	0	67	4.25	0.4	24.9	5.4	0	95	23	43	2.5	0.34	100.8	0.062	0	0	0	2	0	0	0
broccoli	ERS 161	USDA 11093*	1 cup=185g	"0.5, 0.75, 1, 1.25"	0.63	DHQ	1	25.5	2.85	0.2	9.9	7.3	0	384	73	94	1.1	0.24	103	0.033	0	0	0	2	0	0	0
avavado	ERS 15	USDA 09037*	1/4 avocado=49g	"1, 2, 3, 4"	2		2	78.33	0.97	7.47	3.6	1.33	0	29.67	4	5.33	0.3	0.137	30.17	1.186	0	0	0	0	0	0.67	1.1
green peppers	ERS 834	USDA 11822	1 cup=136g	"0.5, 0.75, 1, 1.25"	0.1875	DHQ	4	12	0.4	0.5	5.3	1.6	0	53	151	6	1.2	0.15	14.72	0.012	0	0	0	2	0	0	0
hot chili peper	ERS 892	USDA 11670	1=43g	"1, 2, 3, 4"	0.1875	DHQ	6	17	0.9	0.1	4.1	0.7	0	416	83	7	0.5	0.11	10.35	0	0	0	0	1	0	0	0
onions	ERS 842	USDA 11806	1 cup=210g	"0.5, 0.75, 1, 1.25"	0.38	CSFII	10	29	0.95	0.3	13.1	3.3	0	0	12	57	0.4	0.38	26.89	0.03	0	0	0	2	0	0	0
apple	ERS 1513	USDA 09003*	1 apple=138g	"0.5, 1, 1.5, 2"	0.98	CSFII	6	81	0.3	0.5	21.1	3	0	7	8	10	0.3	0.07	4.14	0.08	0	0	0	0	0	1	0
applesauce	ERS 37351	USDA 09020*	1 cup=244g	"0.5, 0.75, 1, 1.25"	0.55	CSFII	0	149.5	0.45	0.3	39.2	3.5	0	5	3.5	8.5	0.06	0.065	2.55	0.076	0	0	0	0	0	2	1.3
banana	ERS 24	USDA 09040*	1 banana=114g	"0.5, 1, 1.5, 2"	0.97	CSFII	14	105	1.2	0.6	26.7	1.8	0	9	10	7	0.4	0.66	22.42	0.218	0	0	0	0	0	1	0
fruit cocktail	ERS 598/599	USDA 09100/09097*	1 cup=242g	"0.5, 0.75, 1, 1.25"	0.5	DHQ	2	145	1.05	0.1	37.5	3	0	61.5	5.5	17	0.6	1.2	7.28	0.01	0	0	0	0	0	2	1.125
peaches	ERS 876	USDA 09236*	1 peach=98g	"0.5, 1, 1.5, 2"	1.5	DHQ	1	42	0.7	0.1	10.9	1.6	0	53	6	5	0.1	0.02	2.94	0.01	0	0	0	0	0	1	0
canned peaches	ERS 871/872	USDA 09241/09240*	1 cup=257g	"0.5, 0.75, 1, 1.25"	0.625	DHQ	1	165	1.15	0.2	44.35	2.55	0	87	6.5	8	0.8	0.05	7.7	0.02	0	0	0	0	0	2	1.625
grapes	ERS 614	USDA 09132*	1/2 cup=80g	"1, 2, 3, 4"	1.5	DHQ	8	57	0.55	0.45	14.2	0.5	0	5.5	8.5	9	0.2	0.9	3.2	0.15	0	0	0	0	0	1	0
orange	ERS 847	USDA 09200*	1 orange=131g	"0.5, 1, 1.5, 2"	1	CSFII	14	62	1.2	0.2	15.4	3.1	0	28	70	52	0.1	0.08	39.3	0.02	0	0	0	0	0	1	0
pineapple	ERS 925	USDA 09268*	1 cup=249g	"0.5, 0.75, 1, 1.25"	0.5	DHQ	0	149	1.1	0.2	39.1	1.7	0	10	24	35	0.7	0.18	12.45	0.015	0	0	0	0	0	2	0
pears	ERS 883	USDA 09252*	1 pear=166g	"0.5, 1, 1.5, 2"	1	DHQ	5	98	0.7	0.7	25.1	4.3	0	3	7	18	0.4	0.03	11.62	0.037	0	0	0	0	0	1	0
canned pears	ERS 879/880	USDA 09257/09256*	1 cup=258g	"0.5, 0.75, 1, 1.25"	0.625	DHQ	0	169.5	0.5	0.25	44.4	5.15	0	0	2.5	12.5	0.65	0.035	2.58	0.012	0	0	0	0	0	2	1.25
strawberries	ERS 1223	USDA 09316*	1 cup=144g	"0.5, 0.75, 1, 1.25"	0.5	DHQ	6	45	0.9	0.6	10.5	3.9	0	4	85	21	0.6	0.09	25.9	0.075	0	0	0	0	0	2	0
cantaloupe	ERS 761	USDA 09181*	1 slice or 1/2cup=156g	"1, 2, 3, 4"	1.5	DHQ	6	55	1.4	0.4	13	1	0	502	66	17	0.3	0.18	26.5	0.011	0	0	0	0	0	2	0
watermelon	ERS 763	USDA 09326*	1 slice or 1/2cup=152g	"1, 2, 3, 4"	2.5	DHQ	9	49	0.9	0.7	10.9	1	0	56	15	12	0.3	0.22	3.04	0.073	0	0	0	0	0	2	0
cookie	ERS 406	USDA 18165	1 cookie=10g	"1, 2, 3, 4"	4	CSFII	13	47	0.5	2.1	7	0	0	4	0	4	0.3	0.01	3.18	0.774	3.072	0	0	0	0.5	0	0.75
cake	ERS 211	USDA 18140	1 slice=109g	"1, 2, 3, 4"	0.84	CSFII	5	384	3.3	11.4	69.7	1.3	0	78	0	74	1.2	0.03	22	4.65	55	0	0	0	1	0	8
brownie	ERS 167	USDA 18154	1 brownie=34g	"1, 2, 3, 4"	1	DHQ	2	129	1.5	4.6	21.3	1	0	4	0	12	0.8	0.02	8.22	2.075	20.69	0	0	0	1	0	3
pie	ERS 904	USDA 18302	1 slice=150	"1, 2, 3, 4"	1	CSFII	2	454	3.9	21.8	62.2	2	0	2	2	9	1.7	0.04	40.92	5.17	0	0	0	0	1	0.5	10
chocolate candy	ERS 1454/231	USDA 19140	1 oz=28g	"0.5, 1, 1.5, 2"	1.57	CSFII	3	41.4	1.035	2.875	3.91	0.345	0	0	0	11.5	0.115	0.023	2.744	0.81	0.7056	0.07	0	0	0	0	1.05
hard candy	ERS 229	USDA 19107*	3 pieces=18g	"1, 2, 3, 4"	1.83	CSFII	2	69	0	0	17.7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.01
candy bar	ERS 238	USDA 19155*	1bar=57g	"0.25, 1, 2"	0.77	CSFII	8	276	5.8	12.7	33.6	1	0	3	0	66	0.5	0.06	22.8	5.127	7.41	0	0	0	0	0	8
regular ice cream	ERS 662	USDA 19095	1/2 cup=67g	"1, 2, 3, 4"	2.25	CSFII	16	134.5	2.4	7.15	15.85	0	0	66.5	0.5	88	0.05	0.03	3.3	4.481	29.04	0	0.335	0	0	0	4.5
lite ice cream	ERS 1505	USDA 19088	1/2 cup=72g	"1, 2, 3, 4"	2.1	CSFII	1	87	2.6	0.3	18.6	0.5	0	62	0	94.5	0.55	0	3.96	1.73	9.24	0	0	0	0	0	3

Nutrient	Food ID#1(1)	Food ID#2(5)	Reference portion size	Multipliers(6)	Multiplier for standardized portion size (7)	Source of information for standardized portion size	Freqency food reported by subject (10)	Energy	Protein	Fat	CHO	DFIB	Alcohol	Vit A	Vit C	Ca	Iron	Vit B6	FOL	SFA	Chol	Meat	Dairy	Veg	Bread	Fruit	Other
Units								kcal	g	g	g	g	g	RE	mg	mg	mg	mg	mcg	g	mg	serv	serv	serv	serv	serv	serv
frozen yogurt	ERS 1334	USDA 19293	1/2 cup=96.5	"1, 2, 3, 4"	1.56	CSFII	1	103	4.55	1.4	18.85	0.4	0	13.5	0.5	152.5	0.25	0.04	4.32	2.46	1.44	0	0.5	0	0	0	1.5
low-fat yogurt	ERS 1337	USDA 01116*	1/2 cup=123g	"1, 2, 3, 4"	1.5	DHQ	5	75	4.25	4	5.7	0	0	37	0.5	148	0.05	0.04	8.55	2.56	15.925	0	0.5	0	0	0	0.875
fat free yogurt	ERS 1336	USDA 01117*	1/2 cup=123g	"1, 2, 3, 4"	1.5	DHQ	3	77.5	6.45	1.9	8.65	0	0	19.5	1	223.5	0.1	0.06	13.45	1.225	7.35	0	1	0	0	0	0.375
pudding	ERS 995	USDA 19189	1/2 cup=132g	"1, 2, 3, 4"	1.5	DHQ	1	163.5	4.5	3.95	30.1	0.15	0	41.5	1	134.5	0.4	0.055	5.68	2.968	17.04	0	0.45	0	0	0	3.5
granola bar	ERS 1472	USDA 19020*	1 bar=28g	"1, 2, 3, 4"	1	DHQ	3	126	2.1	4.9	19.1	1.3	0	0	0	30	0.7	0.03	6.804	2.053	0.284	0	0	0	1	0	1.5
graham crackers	ERS 437	USDA 18173	4 squares=28g	"1, 1.5, 2, 2.5"	1	DHQ	7	108	2.2	2.6	20.6	0.8	0	0	0	12	1	0.02	16.8	0.426	0	0	0	0	0.5	0	2
regular popcorn	ERS 941	USDA 19035	3 cups=42g	"1, 2, 3, 4"	1.25	CSFII	3	192	4.2	9.3	24.9	4.2	0	2	0	1	0.3	0.02	5.61	1.614	0	0	0	0	1	0	3
lite popcorn	B & C	B&C	3 cups	"1, 2, 3, 4"	1.25	CSFII	0	150	4.2	4.5	20	4.2	0	2	0	1	0.3	0.02		1.1	0	0	0	0	1	0	1.5
fat free popcorn	ERS 940	USDA 19034*	3 cups=24g	"1, 2, 3, 4"	1.25	CSFII	1	93	3	1.2	18.3	3.6	0	1	0	1	0.2	0.01	5.52	0.138	0	0	0	0	1	0	0
nuts	USDA 12635	USDA 12635	1 oz	"1, 2, 3, 4"	1.5	DHQ	6	169	4.9	14.6	7.2	2.6	0	0.28	0.11	19.9	1.05	0.084	14.34	1.96	0	0.5	0	0	0	0	2
coffee	ERS 395	USDA 14209*	6 oz=180g	"1, 2, 3, 4"	2.57	CSFII	20	6	0	0	0.6	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0
hot tea	ERS 1259	USDA 14355*	12 oz=360g	"1, 2, 3, 4"	1.1	CSFII	5	0	0	0	1.2	0	0	0	0	0	0	0	17.76	0.01	0	0	0	0	0	0	0
iced tea	ERS 1260	USDA 14355*	12 oz=360g	"1, 2, 3, 4"	1.1	CSFII	10	0	0	0	1.2	0	0	0	0	0	0	0	17.76	0.01	0	0	0	0	0	0	0
can soda	ERS 115	USDA 14400*	1 oz=31g	"12, 24, 36, 48"	13.6	CSFII	25	12	0	0	3.3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0.37
bottle soda	ERS 115	USDA 14400*	1 oz=31g	"20, 40, 60, 80"	13.6	CSFII	7	12	0	0	3.3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0.37
2 liter	ERS 115	USDA 14400*	1 oz=31g	"16, 32, 48, 54"	13.6	CSFII	8	12	0	0	3.3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0.37
fountain soda	ERS 115	USDA 14400*	1 oz=31g	"22, 32, 44"	13.6	CSFII	12	12	0	0	3.3	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0.37
lemonade	ERS 684	USDA 14543*	12 oz=372g	"1, 2, 3, 4"	1	CSFII	14	144	0	0	39.6	0	0	12	12	12	1.2	0	7.416	0.02	0	0	0	0	0	0.6	4.08
skim milk	ERS 779	USDA 01085*	8 oz=248g	"1, 2, 3, 4"	0.91	CSFII	3	88	8	0.8	12	0	0	152	0	196	0	0.08	12.24	0.288	4.896	0	1.04	0	0	0	0.88
1% milk	ERS 775	USDA 01082*	8 oz=248g	"1, 2, 3, 4"	0.91	CSFII	8	104	8	2.4	12	0	0	144	0	196	0	0.08	12.2	1.608	9.76	0	1.04	0	0	0	0.88
2%milk	ERS 776	USDA 01079*	8 oz=248g	"1, 2, 3, 4"	0.91	CSFII	18	120	8	4.2	12	0	0	136	0	196	0	0.08	12.2	2.912	19.52	0	1.04	0	0	0	0.88
whole milk	ERS 781	USDA 01077*	8 oz=248g	"1, 2, 3, 4"	0.9	CSFII	19	152	8	8	11.2	0	0	72	0	196	0	0.08	12.2	5.072	34.16	0	1.04	0	0	0	2
apple juice	ERS 674	USDA 09016*	4 oz =124g	"1, 2, 3, 4"	2.19	CSFII	7	60	0	0	14.4	0	0	0	0	8	0.4	0.04	0	0.02	0	0	0	0	0	0.68	0
grape juice	ERS 677	USDA 09137*	4 oz =124g	"1, 2, 3, 4"	2.19	CSFII	5	68	0.4	0	16	0	0	0	28	4	0	0.04	1.248	0.036	0	0	0	0	0	0.68	1.32
orange juice	ERS 688	USDA 09215*	4 oz =124g	"1, 2, 3, 4"	2.16	CSFII	20	56	0.8	0	13.6	0	0	8	48	12	0	0.04	54.736	0.01	0	0	0	0	0	0.68	0
tomato juice	ERS 694	USDA 11886*	4 oz=120g	"1, 2, 3, 4"	2	DHQ	1	20	0.8	0	5.2	0	0	68	24	12	0.8	0.12	24.32	0.008	0	0	0	0.68	0	0	0
beer	ERS 99	USDA 14003*	12 oz=360g	"1, 2, 3, 4"	2.46	CSFII	6	144	1.2	0	13.2	0	12	0	0	24	0	0.24	21.384	0	0	0	0	0	0	0	0
wine	ERS 1329	USDA 14084*	5 oz=145g	"1, 2, 3, 4"	1.66	CSFII	1	100	0.5	0	2	0	13.5	0	0	10	0.5	0.05	1.475	0	0	0	0	0	0	0	0
wine cooler	ERS 1327		12 oz=360g	"1, 2, 3, 4"	0.71	DHQ	0	180	0	0	21.6	0	14.4	0	12	24	0.12	0				0	0	0	0	0	6
shot	ERS 1326	USDA 14052*	1.5 oz=42g	"1, 2, 3, 4"	2	DHQ	0	105	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
shredded yellow cheese	ERS 306	USDA 1009	1/ 4 cup=28g	"1, 2, 3, 4"	1.14	CSFII	1	113	7	9.3	0.4	0	0	85	0	202	0.2	0.02	5.103	5.98	29.767	0	0.67	0	0	0	2
shredded white cheese	ERS 311	USDA 1028	1/ 4 cup=28g	"1, 2, 3, 4"	1.14	CSFII	5	78	7.7	4.8	0.9	0	0	53	0	205	0.1	0.02	2.551	2.867	16.443	0	0.67	0	0	0	1
gravy	ERS 622/623	USDA 6119	1/4 cup=60g	"1, 2, 3, 4"	1.27	CSFII	0	48.75	1.1	3.4	3.36	0.1	0	9.25	0.25	31.125	0.1625	0.01	1.19	0.839	1.19	0	0.1	0	6.52	0	0.6
butter	ERS 178	USDA 1001	1 tsp=5g	"1, 2, 3, 4"	2.2	CSFII	10	33	0	3	0	0	0	14	0	3	0	0	0.15	2.524	10.95	0	0	0	0	0	1
margarine	ERS 751	USDA 4561	1 tsp=5g	"1, 2, 3, 4"	2	CSFII	5	34	0	3.8	0	0	0	16	0	1	0	0	0.065	0.835	0	0	0	0	0	0	1
lite margarine	ERS 748	USDA 4128	1 tsp=5g	"1, 2, 3, 4"	2	CSFII	3	17	0	1.9	0	0	0	17	0	3	0	0	0.048	0.37	0	0	0	0	0	0	0.5
salsa	ERS 1101	USDA 6164	1/4 cup=65g	"1, 2, 3, 4"	0.75	DHQ	10	59.75	0.7	0.115	3.2	1.225	0	42.75	13	29.75	0.475	0.075	10.36	0.0195	0	0	0	0.5	0	0	0
guacamole	ERS 627	B&C	1/4 cup=58g	"1, 2, 3, 4"	0.75	DHQ	1	91	1.125	8.6	4.3	1.5	0	34.25	4.75	6.75	0.575	0.16		1.764	2.52	0	0	0.5	0	0	1.875
chili sauce	USDA 06139	USDA 06139	1/4 cup	"1, 2, 3, 4"	0.75	DHQ	5	16.6	0.46	0.1	3.8	0.3	12.6	6.3	8.4	0.02						0	0	0	0	0	0
regular sour cream	ERS 1201	USDA 01056*	1 Tbsp=14.4g	"1, 2, 3, 4"	2	DHQ	7	30.8	0.46	3.01	0.6125	0	0	28.06	0.125	16.75	0	0	1.58	1.876	6.325	0	0.056	0	0	0	0.67
lite sour cream	USDA 01193	USDA 01193*	1 Tbsp=14.4g	"1, 2, 3, 4"	2	DHQ	2	23.56	0.6975	1.86	1.0075	0.0155	0	163.215	0.1705	24.955	0.0095			1.178	7.75	0	0.083	0	0	0	0.335
fat free sour cream	USDA 01194	USDA 01194*	1 Tbsp=14.4g	"1, 2, 3, 4"	2	DHQ	0	14.56	0.752	0.208	2.416	0	0	108.64	0.192	22.56	0.008			0.128	1.44	0	0.075	0	0	0	0
mayo	ERS 400	USDA 4018	1/2 Tbsp=7g	"1, 2, 3, 4"	1.71	CSFII	17	49.5	0.1	10.5	0.2	0	0	6	0	1	0.05	0.04	0.765	0.625	3.3	0	0	0	0	0	1.25
lite mayo	USDA 04011	USDA 04011*	1/2 Tbsp=8g	"1, 2, 3, 4"	1.5	CSFII	1	20.05	0.05	2.48	0.6375	0.01	0	13.88	0.02	0.45	0.02			0.375	2.625	0	0	0	0	0	0.625
fat free mayo	USDA 04013	USDA 04013*	1/2 Tbsp=8g	"1, 2, 3, 4"	1.5	CSFII	0	5.6	0.02	0.216	0.99	0.16	0	7.92	0	0.48	0.01			0.04	0.8	0	0	0	0	0	0
ranch	ERS 1346	USDA 4115	1 Tbsp=15g	"1, 2, 3, 4"	2.47	CSFII	10	54	0.4	5.7	0.6	0	0	0	0	0	0	0		0.88	3	0	0	0	0	0	1.5
lite ranch	USDA 04117	USDA 04117*	1 Tbsp=15g	"1, 2, 3, 4"	2.47	CSFII	0	38.4	0.18	3.42	1.575	0.075	0	6.15	0.015	3.9	0.0285			0.285	4.2	0	0	0	0	0	0.9
fat free ranch	USDA 04119	USDA 04119*	1 Tbsp=15g	"1, 2, 3, 4"	2.47	CSFII	0	24.15	0.1225	0.175	5.355	0.105	0	1.4	0.0175	4.55	0.0105			0.035	0.175	0	0	0	0	0	0
french	ERS 478	USDA 04120*	1 Tbsp=16g	"1, 2, 3, 4"	2.31	CSFII	1	67	0.1	6.4	2.7	0	0	3	0	2	0.1	0	0.624	1.482	0	0	0	0	0	0	2
lite french	B&C	B&C	1 Tbsp=16g	"1, 2, 3, 4"	2.31	CSFII	0	25	0	1.5	3	0	0		0	0	0			0.25	0	0	0	0	0	0	1
fat free french	B&C	B&C	1 Tbsp=16g	"1, 2, 3, 4"	2.31	CSFII	0	22.5		0	3	0.5								0	0	0	0	0	0	0	0
italian	ERS 480	USDA 4116	1 Tbsp=15g	"1, 2, 3, 4"	2.47	CSFII	6	69	0.1	7.1	1.5	0	0	4	0	1	0	0		0.781	0	0	0	0	0	0	2
lite italian	ERS 481	USDA 4118	1 Tbsp=15g	"1, 2, 3, 4"	2.47	CSFII	3	16	0	1.5	0.7	0	0	0	0	0	0	0		0.121	0.093	0	0	0	0	0	0.5
fat free italian	ERS 1424	USDA 4121	1 Tbsp=14g	"1, 2, 3, 4"	2.64	CSFII	0	6	0	0.3	0.9	0	0	0	0	1	0	0		0.05	0.3	0	0	0	0	0	0
sugar	ERS 1230	USDA 19335*	1 tsp=4g	"1, 2, 3, 4"	3.5	CSFII	24	15	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
jelly	ERS 673	USDA 19300	1 Tbsp=19g	"1, 2, 3, 4"	1.05	CSFII	15	51	0	0	13.3	0	0	0	0	1	0.1	0	0.19	0	0	0	0	0	0	0	1.5
honey	ERS 647	USDA 19296*	1 Tbsp=21g	"1, 2, 3, 4"	0.67	DHQ	1	64	0.1	0	17.5	0	0	0	0	1	0.1	0.01	0.42	0	0	0	0	0	0	0	2
liquid cream	ERS 450	USDA 01067*	1 TBSP	"1, 2, 3, 4"	2.1	CSFII	5	20.5	0.15	1.5	1.7	0	0	1.5	0	1.5	0	0	0	0.2905	0	0	0	0	0	0	0.335
powdered cream	ERS 451	USDA 01069*	1 tsp	"1, 2, 3, 4"	3	CSFII	8	10.9	0.096	0.71	1.098	0	0	0.4	0.44	0.44	0.023	0	0	0.65	0	0	0	0	0	0	0.3

Nutrient	Food ID#1(1)	Food ID#2(5)	Reference portion size	Multipliers(6)	Multiplier for standardized portion size (7)	Source of information for standardized portion size	Freqency food reported by subject (10)	Energy	Protein	Fat	CHO	DFIB	Alcohol	Vit A	Vit C	Ca	Iron	Vit B6	FOL	SFA	Chol	Meat	Dairy	Veg	Bread	Fruit	Other
Units								kcal	g	g	g	g	g	RE	mg	mg	mg	mg	mcg	g	mg	serv	serv	serv	serv	serv	serv

(1) Food identifiacation number #1 represents the source of information for energy, protein, total fat, carbohydrates, fiber, alcohol, Vitamin A, Vitamin C, Calcium, Iron, Vitamin B6 and the number of servings of meat, dairy, vegetable, bread, fruit, and other

(2) ERS numbers represent source of nutrient information is the EFNEP Reporting System (ERS); Food items with more than one number indicates an average of two or more ERS foods were made to represent the IMM food

(3) USDA numbers represent source of nutrient information is the USDA Nutrient Database for Standard Reference

(4) B&C numbers represent source of nutrient information is Bowes and Church's Food Values of Portions Commonly Used

(5) Food identification number #2 represents the source of information for folic acid, saturated fat, and cholesterol.

* Foods in the USDA database which were matched identically to foods in the ERS database. (Foods without an asterisk were matched and adjusted as closely as possible to ERS foods).

(6) The four serving sizes represented in the IMM food recall system are indicated by the multipliers. The reference portion size indicated is mulitplied by each number in the multipliers column.

(7) The multiplier for standardized portion size was multiplied by the reference portion size and the product was used as the standardized portion size.

(8) DHQ, Dietary History Questionnaire. Indicates the standarized portion size was derived from the middle portion size represented in the DHQ.

(9) CSFII, Continuing Survey Food Intake by Individuals. Indicates the standarized portion sizes was derived from the 1994-96 CSFII mean Quantities Consumed per Eating Occasion for all individuals age 2 and over

(10) Indicates how many subjects chose the corresponding food in the IMM food recall.

Blank cells indicate unavailable nutrient data

Appendix C: Alpha Testing Questionnaire

Colorado State University
Alpha-Evaluation Instructions
Interactive Multi-Media Dietary Recall System
(Instructions should be read and explained to subjects)

Thank you for helping me test my computerized 24-hour food recall, I appreciate your time! Please realize this program is still in the planning stages and there are glitches in the program that I will point out as you navigate through this program. The primary reason I am having you test my program is because I want your feedback on the best format for the program. We are trying to make a decision between three different formats and the feedback you provide will be critical in the decision making process. Additionally, I am looking for feedback on the quality of the graphics and portion sizes. (Briefly review the survey with them).

The audio on the program is not the best quality, as will be evident as you navigate through the program. In the final program the audio will be recorded in a studio and will be a high quality consistent pitch.

When planning to test this program, only a few foods where selected for the initial testing. These foods are outlined in the menu provided. While navigating through the program it is your job to stick to the menu. If you choose foods not listed in the menu the program will not work correctly because these foods have not been programmed. You will notice a lot of missing graphics and placeholders for future graphics; once again this is because the program is not complete. I will sit with you to observe how easily you navigate through the program and answer any questions as they may arise. This process should take about 45 minutes. Throughout the program and at the end I will ask you for your feedback so that I may use your comments to complete this survey. Any questions? Okay, lets get started!

Order of testing prototypes:

1. prototype 3
2. prototype 1
3. prototype 2

Colorado State University
Alpha-Evaluation Questionnaire
Interactive Multi-Media Dietary Recall System

- **Which format do you prefer?** Prototype 3 (meals individually) or
  Prototype 1 (meals collectively)

- **What do like about prototype 3?**

- **What do you dislike about prototype 3?**

- **What do you like about prototype 1?**

- **What do you dislike about prototype 1?**

- **With prototype 1, all the questions regarding portion sizes and cooking technique was asked after each food had been chosen. With prototype 2 all the questions regarding portion sizes and cooking technique was asked after all the foods had been chosen. Which way do you prefer and why?**

Introduction:

1	**2**	**3**	**4**	**5**
Difficult to Understand				Easy to Understand

Grouping of foods:

1	**2**	**3**	**4**	**5**
Not Appropriate				Appropriate

- **What would you change?**

Flow:

1	**2**	**3**	**4**	**5**
Not understandable				Understandable

Portion sizes:

1	**2**	**3**	**4**	**5**
Not effective				Effective

Quality of graphics:

1	**2**	**3**	**4**	**5**
Not effective				Effective

- **Any suggestions for specific food items?**

Use of ruler to indicate portion sizes:

1	**2**	**3**	**4**	**5**
Not useful				Useful

Announcing portion size of food item:

1	**2**	**3**	**4**	**5**
Not useful				Useful

Additional comments:

Appendix D: 24-hour Training Protocol

Protocol for 24-hour recall training

Prior to data collection:

- ✓ Trainer to review "Procedures for collecting 24-hour recalls" handout with trainees
- ✓ Trainees to read: **Chapter 3** *Interviewing*; Communication and Education Skills of Dietetics Professionals by BB Holli and RJ Calabrese
- ✓ Trainees to read: **Chapter 3** *Measuring Diet*; Nutritional Assessment by RD Lee and DC Nieman
- ✓ Trainees to observe three sample 24-hour recalls collected by trainer
- ✓ Trainees to practice collecting three 24-hour recalls, to be recorded on micro cassette and discuss with trainer
- ✓ Trainer to observe trainee collection of two 24-hour recalls and provide feedback
- ✓ Additional practice by trainee and observation by trainer if needed

During data collection:

- ✓ Trainer to observe a minimum of one 24-hour recall by trainee (at approximately mid-point of data collection period) to monitor proper procedures for collecting a 24-hour recall are being followed

Protocol for FIAS training

Prior to data collection:

- ✓ Trainee to complete FIAS tutorial
- ✓ Trainees and trainer to enter 6 identical 24-hour recalls to monitor for reliability among nutrient profiles, discuss results and inconsistencies

During data collection:

- ✓ Trainer to re-enter a minimum of one 24-hour recall identical to trainee to monitor for reliability among nutrient profiles

Procedures for collecting 24-hour recalls

Setting the Stage for the Interview

1. Build rapport.
2. Explain to the participant that you need to know only what she actually ate. She should not feel embarrassed about any food, as there are no "good" or "bad" foods. No one eats just the right foods all the time. Explain the need for accuracy. You are not judging food choices or amounts.
3. Do not express in words or facial expressions either approval or disapproval of foods the participant mentions.
4. Do not ask leading questions that would lead the homemaker to feel she "should" have had a certain item.

Food Recall Collection Method

1. Use a multiple pass method.
   - 1st: probe for information on foods eaten
   - 2nd: probe for information on serving sizes and preparation methods
   - 3rd: repeat information back to participant
2. Explain this procedure to the client, ex. "First I will just ask you questions regarding your food choices, then we will review the food list and I will ask you details about serving sizes and food preparation methods, and finally I will read the food list back to you so you can check for accuracy of my record."
3. Prior to beginning the recall, explain the form you are using to the participant (some participants feel threatened with an interviewer using a form).

During the Food Recall

1. Start with the first food or beverages items yesterday, ex. "What is the first thing you had to eat or drink yesterday?" Work forward to cover all food and beverages during the previous 24 hours.
2. Use the following types of probes to find out what foods were eaten.
   a. Probing related to time, ex:
      i. "What time did you wake up yesterday?"
      ii. "At what time was this?"
      iii. "Did you eat or drink anything before or after that?"
   b. Probing related to activity, ex:
      i. "What did you do this afternoon?"
      ii. "Did you watch TV last night? Did you eat or drink anything when you watched TV?"
   c. Probing related to place, ex:
      i. "Where did you eat breakfast?"
      ii. "Where did you eat out?"
   d. Probing related to people, ex:
      i. "Did you eat supper with anyone?"
   e. Probing related to eating occasion, ex:
      i. "When was your next meal?"
      ii. "Did you have anything to drink with lunch?"

iii. "Did you eat or drink anything in the afternoon?"
iv. Did you eat or drink anything before bed?"
v. Did you get up during the night and eat or drink anything?"

f. Probing to get more details, ex:
   i. "What else did you have with this meal?"
   ii. "Did you have anything on your bread?"
   iii. "Did you have anything in your coffee or tea?"
   iv. "Did you add anything to your food, such as mayonnaise, cheese, etc?"

3. Encourage as much information as possible about the food item.
   a. Describe combination dishes in detail, ex. "What was on your salad?" "Describe the recipe used for the casserole."
   b. Ask about brand name information and label information if known.
   c. Ask about variety, ex: "What kind of margarine did you have?"
   d. If food was eaten at a restaurant, record the name or type of restaurant.
4. After foods have been recalled, determine the amount of food eaten. Use food models and measuring utensils to assist participant in estimating portion sizes. Amounts of food should be described in as much detail as possible including:
   a. Numbers
   b. Shapes
   c. Dimensions
   d. Volume
   e. Weight
5. After the participant has given a recall of foods and amounts for the entire 24 hours, read the list back and ask for any additional foods or changes.
6. If the participant asks questions regarding nutrition during the time of the recall, ask the participant if you may answer them later when you have completed the recall.
7. Thank the participant for their participation. Do not comment on the recall at this time unless specific questions are asked.

Appendix E: Consent Forms

COLORADO STATE UNIVERSITY
INFORMED CONSENT FOR PARTICIPATION IN RESEARCH PROJECT

(C – Module Review – Food Recall)

PROJECT TITLE: Alternative Strategies of Nutrition Education (for Low Income Hispanics)
(Using Computer Technology to Deliver Nutrition Education to Low Income Persons)

PRINCIPAL INVESTIGATOR: Jennifer Anderson, Ph.D., RD

CO-INVESTIGATOR: Susan Martin Gould, Ph.D., RD
Jamie Zoellner, Graduate Research Assistant

CONTACT NAME AND PHONE NUMBER FOR QUESTIONS/PROBLEMS:
Jennifer Anderson, Ph.D., RD (970) 491-7334
Department of Food Science and Human Nutrition

SPONSORS OF PROJECT: United States Department of Agriculture (USDA),

- Food, Nutrition, and Consumer Services
- Cooperative State Research, Education, and Extension Service (CSREES), National Research Initiative (NRI)

Share Our Strength

The purpose of this project is to evaluate and improve a bilingual nutrition education program for use in public waiting areas.

You will be asked to answer some questions on the computer and through an interview about what you have eaten. The questions will take about 45 – 60 minutes to do. You may choose Spanish or English. When you finish, you will receive $10.

Your answers will help us to improve a program about healthful diets and lifestyles.

This project is for educational research only. There are no known risks. It is not possible to identify all possible risks in research study, but we have taken reasonable safeguards to minimize all known and possible, but unknown, risks.

All information given by you will be confidential (private) and used for research purposes only. No one will have access to any identifying information, such as your name. Your name or other identifying information will not be used with your answers or in any project reports.

Your participation is voluntary. You may stop at any time without penalty or loss of benefits.

Your signature means that you have read and understand this consent form, you have willingly signed it, and you have received a copy of these _2_ pages.

____

Participant name (printed)

____________________________________ ____________________

Participant signature Date

____________________________________ ____________________

Investigator or co-investigator signature Date

PARENTAL SIGNATURE FOR MINOR PARTICIPANT

As parent or guardian, you give permission for

______________________________ (print name) to participate in the described research. The nature and general purpose of the project has been satisfactorily explained by ______________________________ and you are satisfied that proper precautions are to be followed.

____

Minor's date of birth

____

Parent/Guardian name (printed)

____________________________________ ____________________

Parent/Guardian signature Date

UNIVERSIDAD DEL ESTADO DE COLORADO (COLORADO STATE UNIVERSITY)

CONSENTIMIENTO INFORMADO PARA PARTICIPACIÓN EN UN PROYECTO DE INVESTIGACIÓN (C – Repaso del módulo – Reviso de Alimentos)

TÍTULO DEL PROYECTO: Estrategias Alternativas de Proveer Educación Nutricional (a Hispanos de Bajos Ingresos)
(Utilizando La Tecnologia del Computadora para Dar La Educación De Nutrición a Los Personas de Bajos Ingresos)

INVESTIGADORA PRINCIPAL: Jennifer Anderson, Ph.D., RD

CO-INVESTIGADORA(S): Susan Martin Gould, Ph.D., RD;
Jamie Zoellner, Estudiante Licenciado

NOMBRE Y NUMERO DE TELÉFONO PARA INFORMACIÓN Y PREGUNTAS:
Jennifer Anderson, Ph.D., RD (970) 491-7334
Department of Food Science & Human Nutrition
(Departamento de Ciencia de los Alimentos y Nutrición Humana)

PATROCINADOR DEL PROYECTO:
U.S. Department of Agriculture (Departamento de Agricultura de los Estados Unidos)

- Los Servicios de Consumo, Nutrición y Alimentos (Food, Nutrition, and Consumer Services)
- El Servicio de Extensión, Educación e Investigación Cooperativeo del Estado (Cooperative State Research, Education, and Extension Service)
  La Iniciative de Investigación Nacional (National Research Initiative)

Compartir Nuestras Fuerzas (Share Our Strength)

El propósito de este proyecto es evaluar y mejorar un programa bilingüe de computadora sobre la educación de la nutrición que será usado en salas de espera de lugares públicos.

Se le pedirá al participante que conteste algunas preguntas en la computadora y por una entrevista sobre los alimentos que usted ha comida. Los cuestionarios se puede llenar en casí cuarenta y cinco a sesenta (45-60) minutos y está escrito en inglés o español. Al terminar, recibirá diez dólares.

Sus respuestas nos ayudarán a mejorar un programa acerca de dietas y estilos de vida saludables.

Este proyecto es, solamente, una investigación educacional. No se sabe de ningún riesgo a Ud. No es posible identificar todos los riesgos de una investigación experimental; pero los investigadoras han establecido medidas de seguridad razonables para disminuir ambos los riesgos conocidos y los riesgos potenciales.

Todas sus respuestas serán confidenciál (privadas) y se usarán solamente para asuntos de investigación. Nadie tendrá acceso a cualquier información que identifica al participante como nombre. Su nombre no se usará en el análisis de la investigación.

Su participación es voluntaria. Puede terminar cuando quiera sin castigo o pérdida de beneficios.

Su firma certifica que ha leído y comprendido esta forma de consentimiento, la ha firmado de buena voluntad, y ha recibido una copia de estas dos (2) páginas.

____
Nombre del Participante (en letra de imprenta o de molde)

____ ___________________
Firma del Participante Fecha

____ ___________________
Firma de la Investigadora/Co-Investigadora Fecha

FIRMA DE UNO DE LOS PADRES DE UN(A) PARTICIPANTE DE MENOR EDAD

Como el padre o el guardián, usted autoriza a ___________________________ (escriba nombre y apellido en letra de imprenta o de molde) a participar en la investigación descrita. El Sr.(a)___________________________ le ha explicado la naturaleza y el propósito general del proyecto de investigación y está satisfecho(a) con las precauciones apropiadas que se van a seguir.

____
Fecha de Nacimiento de Menor de Edad

____
Nombre de Padre/Guardián (Letra de Molde)

____ ___________________
Firma de Padre/Guardián **Fecha**

Appendix F: Opinion Survey

COLORADO STATE UNIVERSITY

Please circle one. How do you best like to report foods you ate?



Pencil & Paper Touch screen computer

Interviewer

Please circle the face that shows how you feel about the touch screen computer food recall program.

Was the touch screen easy to use?

Was the introduction helpful?

Did the meal times make sense to you?

Was it easy to find the foods you ate?

Was it easy to find the portions you ate?

Was the computer food recall easy for you to use?

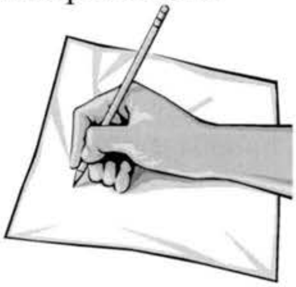
Please list any foods you could not find in the food recall:

What would you change about this program?

Additional comments:

LA UNIVERSIDAD DEL ESTADO COLORADO
Colorado State University

Por favor encerre en un círculo el modo que le gusta mas para exponer los alimentos que comió.



Lápiz y Papel   Pantalla de tacto sensible   Entrevistador/a

Marque la cara (expresión) que representa como Ud. sienta sobre el programa con la pantalla de tacto sensible.

¿Fue la pantalla (de tacto sensible) fácil usar?

¿Fue útil a usted la introducción?

¿Tenían sentido los horas de los alimentos?

¿Les encontró las comidas con fácilidad?

¿Les encontró los porciones con fáclidad?

¿Le encontró el programa fácil usar?

Por favor haga una lista de las comidas que no podía encontrar en la programa:

¿Cuales cosas cambiaría acerca de este programa?

Otras observaciones: