University of Nevada, Reno

Comparison of Children's 24-Hour Recalls and Food Records Using Two Methods of Analysis

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Nutrition

by

Katherine M. Nielsen

Karen Spears Ph.D., R.D./Thesis Advisor

May, 2009

University of Nevada, Reno
Statewide • Worldwide

THE GRADUATE SCHOOL

We recommend that the thesis
prepared under our supervision by

KATHERINE M. NIELSEN

entitled

Comparison of Children's 24-Hour Recalls and Food Records Using Two Methods of Analysis

be accepted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

Karen Spears Ph.D., R.D., Advisor

Jamie Benedict Ph.D., R.D., Committee Member

Janet Usinger Ph.D., Graduate School Representative

Marsha H. Read, Ph. D., Associate Dean, Graduate School

May, 2009

ABSTRACT

The purpose of the study was to determine which dietary assessment method, the 24-hour recall or the food record, would yield data that equates the greatest to the Spears Point-of-Sale-Dietary-Assessment-Tool (Spears POS-DAT). The second purpose of the study was to determine which analysis method, the conventional approach or the reporting-error-sensitive approach, accurately reflected a child's reported dietary intake determined by 24-hour recall or food records in comparison to the Spears POS-DAT.

A descriptive, quantitative study was conducted. Subjects were fourth and fifth grade children enrolled in the 2006-2007 school year at a local charter elementary school (n=40). For two weeks Spears POS-DAT values were obtained at lunch to determine the actual amount of foods eaten. During this time, students kept a 3-day food record and were interviewed to obtain a single day 24-hour recall.

Data was analyzed for 24-hour recalls and food records using two different analysis methods. The conventional method compared mean reported intake to mean reference intake (from the Spears POS-DAT) by converting food into energy and macronutrients. The reporting-error-sensitive method classifies items as matches, omissions, or intrusions and amounts as corresponding, over or unreported. Paired *t*-tests, correlation coefficients, report rates (reported amounts/reference amounts x 100) and correspondence rates (corresponding amounts from matches/reference amounts x 100) were calculated.

Conventional analysis for 24-hour recalls found significant differences for mean protein ($p=0.04$) and carbohydrates ($p=0.05$), but not for energy ($p=0.09$) or fat ($p=0.33$).

Report rates ranged from 124%-131%, indicating over-reporting. Food records had no significant differences between mean reported and mean reference amounts for energy and macronutrients, with food record report rates ranging from 95% to 112%.

Reporting-error-sensitive analysis found significant differences between energy and macronutrients for 24-hour recalls and food records when comparing mean reference amounts to mean corresponding amounts from matches (all p-values < 0.001). Correspondence rates for 24-hour recalls were 61% to 67% and 60% to 67% for food records.

Based on conventional analysis, food records were more accurate than 24-hour recalls; this was not substantiated by the reporting-error-sensitive analysis. Conventional methods overestimated reporting accuracy. The reporting-error-sensitive analysis method provided additional information regarding reporting accuracy. Further studies are needed to confirm these findings.

ACKNOWLEDGMENTS

I want to extend my sincere thanks to everyone who has helped me along my path toward the realization my degree. To begin, I especially want to express my gratitude to Dr. Karen Spears, my advisor, whose patience, diligence and expertise kept me going and focused toward the completion of this thesis. I would not have been able to achieve this success without her guidance. I would also like to express my appreciation to my committee members, Dr. Jamie Benedict and Dr. Janet Usinger for their valuable insight. In addition, I would like to thank the University Of Nevada Cooperative Extension Faculty who helped make this study possible, as well as the school and students for their participation. All this would not have been possible without the faithful support of my husband Rob, who endured this long process with me and offered encouragement and support. Finally, I would like to thank my parents for instilling in me the value of education.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE: INTRODUCTION

An accurate assessment of food intake in children is important because many of the diet-related chronic diseases of adulthood may be rooted in childhood. In 2001 the U.S. Surgeon General stated that children who have an unhealthy diet and low levels of physical activity are at greater risk for developing chronic health problems (1). The importance of this is reinforced in Healthy People 2010 Chapter 19: Nutrition and Overweight which states as one of its objectives that behaviors to promote health should start early and continue throughout life with the development of healthful eating habits (2). Research has shown that overweight children may begin to experience health consequences and go on to increase their risk for chronic diseases in adulthood (3). Overweight children have been found to have risk factors for cardiovascular disease, including lipid profile changes, elevated insulin levels, and increased blood pressure (4). Additional health effects during childhood and adolescents may include glucose intolerance and type 2 diabetes, sleep apnea, asthma, hepatic steatosis, orthopedic complications, and social consequences such as poor self-esteem and social discrimination (3). There is also increasing evidence that sources of nutrients and dietary patterns have an impact on health outcomes (5-8). Therefore it is important not only to examine energy and macronutrients, but also to evaluate dietary intake at the food-item level.

Determining if current dietary assessment techniques and analysis methods are valid indicators of what children consume is essential. Needs assessments, program interventions and evolutions of public policies often hinge on accurate dietary intake assessment. Substantial efforts have been undertaken to improve dietary assessment

techniques, yet the ability to accurately and reliably determine dietary intake remains elusive.

The barriers to accurate dietary assessment in children are similar to those found in adults, which include response bias, reliance on memory, difficulty assessing portion sizes, and variation within an individual's diet (9). In children, assessment problems are even more difficult due to immature cognitive skills, and limited experience with food and food preparation methods (10). The most often used assessment tools are the 24-hour dietary recall and the food record or food diary. A new Spears Point-of-Sale-Dietary- Assessment-Tool (Spears POS-DAT) has been developed to address shortcomings of the 24 hour recall and food record in children (11). How dietary intake is analyzed has also been questioned. Therefore, the review of the literature will address five issues: 1) definition of the 24-hour recall, food record, and the Spears POS-DAT, 2) the strengths and weaknesses of these methods, 3) variables affecting dietary assessment, 4) validation studies for the 24-hour recall, food record, and the Spears POS-DAT intake methods, and 5) methods regarding how dietary intake is analyzed.

CHAPTER TWO: REVIEW OF THE LITERATURE

I. Definition of the 24-Hour Dietary Recall, Food Record, and the Spears Point-of-Sale- Dietary-Assessment-Tool (Spears POS-DAT)

24-Hour Recall

The 24-hour recall is a method of obtaining information about dietary intake. The data is obtained through a structured interview during which detailed information about everything the respondent had to eat and drink from midnight to midnight of the previous day, or over the past 24-hour period, is obtained (12). The interviewer asks questions in a nonjudgmental manner and has a neutral attitude towards all responses. It is also important that open-ended questions are asked and, when probing for additional information, the interviewer avoid asking questions that might influence the subject's responses. Portions reported need to be as accurate as possible, therefore during the interview various visual aids are often used. Examples of portion estimation tools include measuring cups and spoons, common sizes of mugs, glasses, bowls and plates, food models, and food photographs.

The 24-hour recall is the most widely used method for obtaining quantitative dietary data (9, 12). This method has been used by the National Center for Health Statistics for collecting dietary information for the National Health and Nutrition Examination Surveys (NHANES) (13) and by the U.S. Department of Agriculture (USDA) for the Nationwide Food Consumption Surveys and the Continuing Surveys of Food Intakes by Individuals (CSFII) (14), which have now merged to become What We Eat in America. The recall method was also used in nutrition-related clinical trials such as the Multiple Risk Factor Intervention Trial (15), the Dietary Intervention Study in

Children (DISC)(16), and the Child and Adolescent Trial for Cardiovascular Health (CATCH) (10).

Food Record

The food record or food diary method of dietary intake assessment requires an individual to record everything that was consumed over a specified period of time, usually 3-7 days (9, 12, 17). Ideally food intake is recorded at the time the foods are eaten to decrease the reliance on memory. Subjects should also have advanced instruction on how to keep a complete and accurate food record. Portion sizes are quantified by weighing, use of household measures such as measuring cups and spoons, or by food-specific units such as a "medium" banana or a "can" of soda. Food records should be reviewed by an individual knowledgeable about nutrient analysis to determine if the subject has provided enough detail in describing foods and preparation methods, as well as portion sizes for analysis.

Spears Point-of-Sale-Dietary-Assessment-Tool (Spears POS-DAT)

The Spears POS-DAT uses a bar code scanning system similar to those at grocery check-out stations. Subjects present their tray of food items at the check-out station and a staff member then generates a computer inventory of foods selected by scanning package bar codes and weighing food items. Each tray number is coded to a specific participant. Items remaining on their returned tray are then weighed and subtracted from their inventory to calculate actual nutrient intake (11).

II. Strengths and Limitations of the 24-Hour Dietary Recall, Food Record and the Spears Point-of-Sale-Dietary-Assessment-Tool (Spears POS-DAT)

The 24-hour recall and food record methods share several strengths. Both methods are open-ended so that any single food item, food combination, preparation method, or amount can be accommodated. Recalls and records may be more useful for obtaining intakes from culturally diverse populations since they allow inclusion of ethnic foods not commonly included in FFQ's. Finally, the 24-hour recall and food record methods allow for flexibility in data analysis, since data can be analyzed by nutrients, by comparison to the food pyramid, or by matching of food items from individual foods, meals or food groupings and in terms of the amounts under or over-reported.

A major strength of the 24-hour recall compared with food records is that subjects are less likely to alter eating behavior, since the information is obtained after consumption. Another strength is that 24-hour recalls do not require literacy and have a higher response rate due to minimal burden on the respondent (9, 12, 17).

The main limitations of the 24-hour recall method are reliance on memory and the requirement that the respondent think abstractly in order to estimate portion sizes (18). In addition, the recall requires a trained dietary interviewer.

One advantage of the food record is that it does not rely on memory, provided subjects follow the instructions by recording foods and amounts at the time they are consumed. Another advantage is that portion sizes can be directly measured or compared to measuring aids rather than estimated from memory (9, 12). A disadvantage of the food record is that it requires keeping detailed food records with the need for reading and

writing skills, placing a higher burden on the subject than the 24-hour recall. This can lead to poor response rates as well an alteration in usual food intake (9, 12, 17).

The 24-hour recall and the food record methods are unable to estimate habitual or usual intake, since a single day or group of days are unlikely to account for variations in individual diets. For this reason, these methods are best used to describe mean values for groups rather than to estimate usual individual intakes (12).

The Spears Point-of Sale Dietary Assessment Tool has the advantage of removing the burden of data entry from the subject, which makes it well suited for studying the dietary intake of children. There are also no literacy or memory requirements and it is non-intrusive, potentially reducing the alteration in normal mealtime patterns. In addition, the Spears POS-DAT is based on weighed information, therefore improving data accuracy. The main limitation of this tool is that it requires a congregate meal site. Other limitations may include cost and portability of the equipment (11).

III. Variables Affecting the Outcome

Several variables have been found to impact dietary assessment. Figure 1 illustrates the complexity of dietary reporting. The variables most pertinent to this study are age and cognitive development.

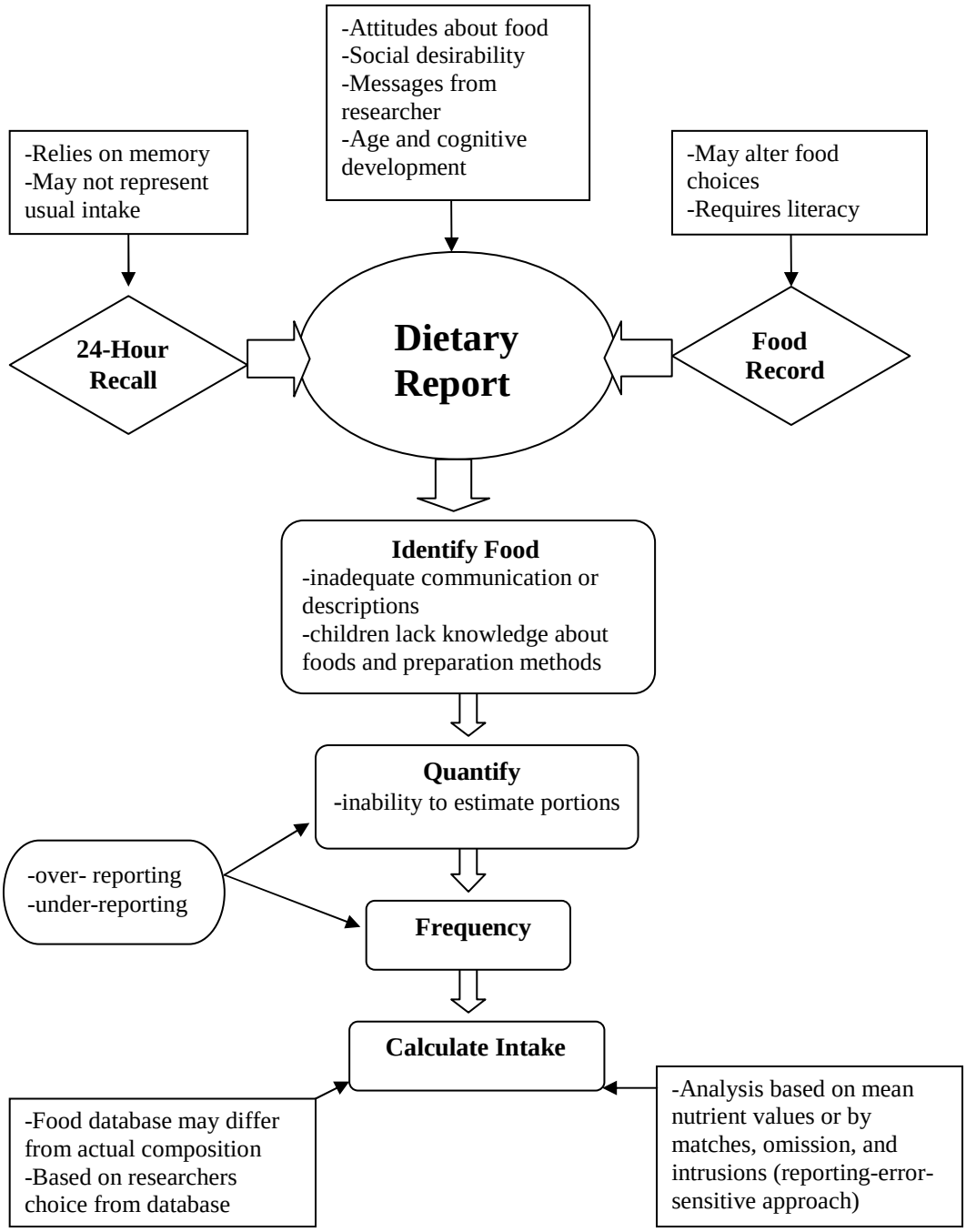

Figure 1 The process of dietary assessment, adapted from (9).

Age and Cognitive Development

Cognition is "the knowledge we possess, the organization of this knowledge, and the processes we have available to us for using this knowledge in the everyday activities

of attention, learning, memory, comprehension, and problem solving" (19). Cognitive development is the changes that occur in cognition as children age (19). Self-reported information about dietary intake reflects cognitive processes. The accuracy of the data is affected by the child's ability to perform certain tasks and by the knowledge that is possessed about food. For example, a food record requires that children can recognize foods and legibly write them down, as well as describe quantities in whole units and fractions (18). A food recall also requires a child to access information from memory and necessitates that the child think abstractly about certain foods while viewing food models or measures of different volumes and dimensions and then estimate what they consumed (18).

In an attempt to understand children's self-reports of food intake, a model of cognitive processing for these tasks has been proposed by Baranowski and Domel (20). The model consists of a sensory register, short-term memory, and long-term memory and can be applied to seven categories of error in children's dietary reporting: attention, perception (or interpretation), organization, retention, retrieval, recognition, and response (20). Attention refers to noticing information; therefore, if a child does not notice some aspect of what was eaten the child will be unable to recall it in the future. Perception or interpretation involves correctly identifying certain foods. Organization refers to how the child categorizes food information into long-term memory and impacts the retrieval of information from memory. Retention is the ability to retain dietary information in a child's memory and usually deteriorates over time, while retrieval is the process of extracting information from long-term memory and transferring it to short-term memory to form a response. Finally, the response of the child may be influenced by how the child

wants to be perceived. This may result in a distortion of food intake due to social desirability and would include over-reporting foods that are considered healthful and under-reporting those foods considered unhealthful (20).

The knowledge of how children organize and retrieve dietary information may help shape strategies for gathering dietary data from children. This will be influenced by what stage of development the child is in and to what extent more advanced skills in storing and processing information have been acquired It is also important to note that children of the same age may be at different stages of cognitive development.

IV. Validation Studies for 24-Hour Dietary Recalls, Food Records and the Spears POS-DAT

Multiple research studies have addressed the validity of the 24-hour recall method. Fewer studies have been conducted on the validation of food records and Spears POS-DAT. The primary techniques used to validate children's reported intake are: leftover analysis (which examines the amount of food and beverage that remain after finishing the meal) and observational analysis (which uses trained observers to record what children eat and drink at a meal). Double labeled water (DLW) has also been used to validate self-reports of dietary intake, but this method is limited by its ability to only assess energy intake/expenditure and therefore will not be included in the review (21, 22). Recently the Spears POS-DAT was validated against the direct observation dietary assessment technique (unpublished data).

Validation Studies Using Leftover Method

Leftover analysis was used in two studies to validate children's recall. In both studies, reference lunch consumption was determined by placing a slip of paper on the

child's tray and recording the items taken. When the child finished lunch, the tray was taken to the disposal area where any leftover food was recorded and measured before being discarded. The child recalled the food items and quantity consumed for the reference meal. The length of time between lunch and dietary recall differed substantially between the two validation studies. Meredith et al (23) conducted recalls soon after lunch (30 min. to 2 hrs) while Emmons et al (24) waited until the next day (standard 24-hour recall design). The age ranges for these two studies were 9-18 year olds (23) and 6-12 year olds, respectively (24).

Even though the recall was sooner and the children were older, Meredith et al found that only 6 of the 94 records (6%) were in agreement in all parameters that included number, kind and quantity of reference vs. recalled items (23). Their criterion for agreement was very literal and did not allow for any deviations. In comparison, an average of 80.6% of foods eaten were correctly identified by the fourth grade children in the Emmons and colleagues study (24). This high number of agreement, in contrast to the Meredith et al study, may be the result of less stringent criterion for matches by only requiring identification of the food item, not the correct quantity of reference vs. recalled items. Although there was lack of agreement by comparison of the items recorded, the differences were relatively small in both studies when compared to calculated nutrient analysis. This may be due to the fact that items recalled incorrectly may have had similar nutrient values to those actually consumed.

Validation Studies Using Observation Method

Trained observers were used to validate children's 24-hour recalls (10, 25-27) and food records (26, 28, 29). Direct observations occurred at lunch and/or breakfast and in

the subject's home to obtain actual intakes. The vast difference in execution of the 24-hour recalls and food records hinders direct comparison of study findings. For example, the protocols in some studies deviated from the traditional method by having children keep a food journal as a memory prompt in a 24-hour recall, or by delaying when children logged their intake for food records, rather than concurrently or right after consumption.

A study conducted by Carter, et al provides an example of a 24-hour recall validation study using trained observers (25). They evaluated the validity of the 24-hour recall method over a full day's intake in 10-12 year old children who were attending summer camp for children with chronic diseases (n=28). The results indicated poor validity of the 24-hour recall method for measuring energy and protein intakes. The paired *t*-tests found a significant difference between mean observed and recalled intakes of kilocalories (2,348 kcal vs. 1,896 kcal $p \leq 0.002$) and protein (82 grams vs. 66 grams; $p \leq 0.004$), respectively (25).

Several validation studies were hybrid studies evaluating different dietary assessment methods within the same study. The Child and Adolescent Trial for Cardiovascular Health (CATCH), conducted a pilot-test utilizing face-to-face 24-hour recall interviews assisted by food records in a sample of third-graders (n=49)(10). On day one of the study, children were instructed to list the foods they had consumed (without portion sizes) for 24 hours starting at breakfast. The following morning 24-hour recall interviews were conducted utilizing the food record they had completed as a memory aid (10).

The CATCH study found no significant differences between recalled and observed nutrient intakes when nutrient levels were expressed as percentages of energy or fat intake. However, when comparing the energy intake, there was a significant difference between mean observed (1649.8 ± 555.4) and mean recalled (1822.5 ± 630.7) ($p < 0.05$). Overall there was a 77.9% agreement of foods reported and observed. Study results indicated that children were able to recall the food items but not portion sizes of the foods consumed during the previous 24-hour period with the aid of a food records (10). The authors concluded that the results of this study suggested 24-hour recalls assisted by food records could be useful in assessing the diets of third-grade children.

Another study examined the use of food records in conjunction with 24-hour recalls. As part of the 5 A Day Power Plus Project in St. Paul, Minnesota, fourth-grade students provided 24-hour recalls with or without a non-quantified food record (food record without portion sizes) (27). The findings were reported in two sub-studies: Food Record Validation Study (n=139) and Recall Validation Study (n=486). In both studies researchers support the use of 24-hour recalls with food record prompts.

The Food Record Validation Study (27) supports the findings of the CATCH study. Of the 15 foods and nutrients analyzed, 60% had higher correlations between recalled and observed values when a food record was used. Use of a food record prompt resulted in significantly higher correlations for servings of fruit per 1,000 kcal ($p=0.007$) and for servings of fruit and vegetable per 1,000 kcal ($p=0.009$) compared to observation. However, when difference in mean intake between observed and 24-hour recalls using food record prompts vs. not using food record prompts were compared, there was little evidence of benefit from using a food record. In fact, use of a food record resulted in a

significant increase in the difference between observation and 24-hour recall compared with not using a food record ($p < 0.02$) (27).

In the other sub-study of the 5 A Day Power Plus project, the Recall Validation Study evaluated observed intake to 24-hour recalls with non-quantified food record prompts (n=486). This study differed from the Food Record Validation Study by focusing on the difference between observed intake to 24-hour recalls with non-quantified food records (they excluded the difference between observation and 24-hour recalls without food record prompts). In contrast to the Food Record Validation Study that found conflicting evidence of benefit from using a food record, this study reported significant differences between mean recalled and mean observed values for energy, servings of fruit, servings of fruit and vegetables and for grams of fiber, with recalled amounts greater than observed (all p-values < 0.001) (27).

The Growth and Health Study (GHS) of the National Heart, Lung and Blood Institute conducted a study to determine the most valid method of assessing dietary intake in 9 and 10 year old girls (n=60)(26). The girls were randomly assigned into one of the three methods: 24-hour recall, 3-day food record, and food frequency (limited to 5 days). The study findings indicated that the 3-day food record group had the lowest differences between observed and reported intakes for energy and the five nutrients (protein, carbohydrates, fat, saturated fat, and cholesterol) compared with the 24-hour recall and the 5 day food frequency. The 3-day food record was found to be a better indicator of intake compared to the 24-hour recall and the 5-day food frequency in relationship to

percentage of absolute errors[1] (PAEs) (12%-22%), Spearman correlations (0.78-0.94), percentage of missing food items (25%), and the fewest number of phantom foods (10%). The 24-hour recall had ranges between 19%-39% for PAEs and correlation ranges of 0.46 to 0.79 (26).

Domel et al conducted one of the few studies that solely examined the validity of food records (28). They compared food records of fourth and fifth grade children to school lunch observations. Each class received training on how to fill out the food records, which consisted of seven diary forms, written instruction, sample page, and a practice page. The study food record protocol differed from usual simultaneous recording of intake with meals. The records remained at school and were written in twice a day: each morning (to record after-school snacks, supper and evening snack for the day before and breakfast that day) and after lunch (to record lunch that day). Students were also given a form on Friday to take home and record food eaten over the weekend.

The students were divided into one of two monitoring approaches Daily Monitoring Approach (DMA) or Weekly Monitoring Approach (WMA). The DMA involved a daily check by trained data collectors to ensure writing was legible and items and number of servings had been recorded: they also probed students for forgotten items. The DMA was administered for 2 weeks. The WMA involved checking once each week that items and numbers of servings had been recorded. The WMA was administered for 3 weeks. Students were randomly observed during lunch to obtain reference food intakes (28). A total of 117 observations and food records were matched.

---

[1] Percentage absolute errors (PAEs) were computed between missing foods (*observed* food items *not reported*) and phantom foods (*reported* food items *not observed*). Therefore, PAE is defined as the absolute value of the following: [observed value (g) – reported value (g)/observed value (g)] x 100.

Pearson correlations calculated between observed amounts and the number of servings listed on the food record varied considerably for the different meal categories. Students were more accurate in completing their food records with the more labor intensive daily monitoring approach. The correlation values for the DMA ranged from 0.16 to 0.85 and were significant ($p < 0.001$) for eight of nine meal items. The meal item categories included, main course, vegetable or fruit, another vegetable or fruit, bread, grain, dessert (fruit), dessert (non-fruit), milk, and other food items not served with school lunch. Grain (rice or pasta) was the only food category that was non-significant by the DMA, but no p-value was reported. The WMA correlation value ranged from -0.21 to 0.69 and was significant for three out of the nine food items; 1) vegetable or fruit ($p < 0.001$) 2) dessert (fruit) ($p < 0.001$), and 3) bread ($p < 0.01$). Again, for non-significant food items, no p-value was indicated. Overall, under-reporting was more common than over-reporting (28).

Validation of the Spears POS-DAT vs. Direct Observation

Recently the Spears POS-DAT was validated against direct observation which is considered the "gold standard" (30) Data was obtained from kindergarten to fifth grade students (n=157) for eighteen days with a total of 700 lunch trays evaluated. The mean difference between direct observation and the Spears POS-DAT for school lunch energy and nutrient intake did not significantly differ ($p < 0.0001$) with correlation coefficients ranging from 0.53-0.81 (unpublished data).

V. Methods Regarding Analysis of Dietary Intake

The accuracy of dietary self-reports has traditionally been assessed by calculating the average reported nutrient intake in comparison to the average nutrient values obtained

by a reference method such as observation. Using an average value to determine the accuracy of self-reported nutrient intake may lead to misrepresentation of "actual" food and beverage intake. Researchers have postulated that this may be due to the fact that items reported may have similar nutrient values compared to those items that were actually consumed. For this reason the reporting-error-sensitive analysis approach has been constructed by Baxter et al to potentially capture a more accurate assessment of dietary intake (31-38). Figure 2 illustrates the process of assessing dietary information using the reporting-error-sensitive approach.

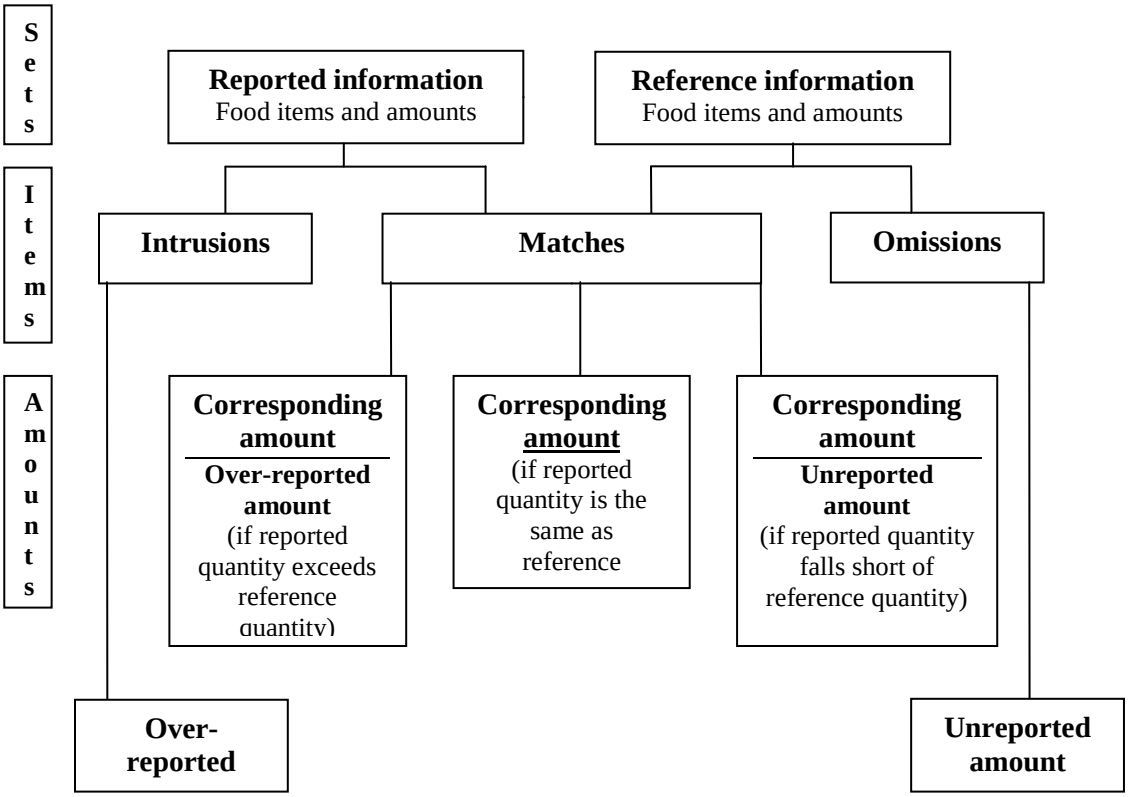

Figure 2 Reporting-error-sensitive approach to analysis of dietary information. In this approach, reported and reference items are classified as intrusions (reported items not in the reference set), matches (reported items in the reference set) and omissions (reference set items not reported). Amounts – of servings or of energy and nutrients – are classified as over-reported (reported but not in the reference information), corresponding (reported and in the reference information) and unreported (in the reference information, but not reported)(38)

This approach has been utilized in five studies (31, 34-37). In addition, three studies compared the conventional method of diet analysis to the reporting-error-sensitive methods of analysis (32, 33, 38). In general these studies found conventional analysis over estimated reporting accuracy and that under-reporting was common.

An example of a validation study for the reporting-error-sensitive analysis method was conducted by Baxter and colleagues (2002) (36). The accuracy (validity) and consistency (reliability) of fourth-graders' recalls of school breakfast and school lunch were compared with observed intake. Recalls and observations occurred up to 3 times, with 4 to 14 weeks between each interview. Accuracy is the extent to which a child's recall provided correct information compared with observations. Consistency is the degree to which a child's accuracy varied from one day to another. Only children who participated in school breakfast and school lunch were observed. On the morning after school breakfast and school lunch had been observed, 24-hour dietary interviews were conducted following the multiple-pass protocol.

Analysis examined match[2], omission[3], and intrusion[4] rates to determine accuracy of a child's ability to report items. To determine accuracy for reported amounts, absolute and percent differences were calculated between amounts observed and reported eaten. Observed amounts were recorded as none, taste, little bit (or some), half, most, all, and more than one serving, and were scored as 0.0, 0.1, 0.25, 0.5, 0.75, 1, and 2 servings

[2] Match rate = 100 – omission rate. Match rates ranged from 0% to 100%, with 100% considered perfect.
[3] Omission rate = [sum of weighted omissions/(sum of weighted omission + sum of weighted matches)] x 100. Omission rates ranged from 0% to 100%, with 0% considered perfect.
[4] Intrusion rate = [sum of weighted intrusion/(sum of weighted intrusions + sum of weighted matches)] x 100. Intrusion rates ranged from 0% to 100%, with 0% considered perfect.

respectively. A total inaccuracy equation[5], expressed in servings, was used to determine inaccuracy in both reporting items and amounts. For determining consistency, intraclass correlation coefficients (ICC) were calculated. The ICC used omission rate, intrusion rate, and total inaccuracy in a mixed-model analysis of variance (36).

Across all 275 observations and recalls, there was a 35% match rate, 41% omission rate, and a 24% intrusion rate. Mean number of servings for total inaccuracy was 7.1 and decreased significantly from the first to the third recall ($p=0.006$). The ICC for total inaccuracy was 0.29 indicating there was less variability of total error from child to child than within children. For omission rates the ICC was 0.15, meaning that the variability within a child (from one recall to another for the same child) was greater than the variability between children (recalls from one child to another). For matches, the mean difference per serving in amounts reported was -0.08; this indicated an overall tendency to underreport the amount actually eaten (with the mean absolute difference per serving at 0.24) (36).

The data from the Baxter et al (2002) study described above was also analyzed comparing the conventional and the reporting-error-sensitive analysis methods. (32). Again, reporting-error-sensitive analysis evaluates reported intake in terms of matches, omissions, and intrusions. For the conventional method, reported and actual intakes were converted to energy and macronutrients presented as means or conventional report rates[6].

---

[5] Total inaccuracy = (absolute difference between each match x statistical weight) + (each omitted amount x statistical weight) + (each intruded amount x statistical weight) summed over all items at school breakfast and school lunch on an individual day for each child. A score of zero indicated a perfect recall compare to observation.

[6] Conventional report rate = (reported amount/reference amount) x 100. A report rate has a lower bound of 0% (which indicates nothing was reported, but no upper bound (because there is no limit on what an individual can report).

For the conventional approach, energy and macronutrient reported means were significantly less than energy and macronutrient observed means (all p-values < 0.0003). There was no systematic bias for mean reported or mean observed amounts for energy or any macronutrient over the three interviews nor did mean conventional report rates vary systematically between interviews (all p-values > 0.61). However, study findings differed when using the reporting-error-sensitive analysis approach. Mean correspondence rates[7] for energy and each macronutrient increased with each additional interview (all p-values < 0.04); therefore indicating reporting accuracy improved with practice. In addition, the study found the accuracy of a child's reporting by reporting-error-sensitive analysis was not as good as what was indicated by conventional measures. The mean rates of correspondence reporting-error-sensitive analysis were lower (42%, 47% and 53% for energy, 1st to 3rd recall), than the mean conventional report rates (83%, 81%, 82% for energy, 1st to 3rd recall) (32).

Baxter et al have also used the reporting-error sensitive analysis in fourth-grader population to examine 1) the impact of gender, ethnicity, meal component and time interval (same day, next day and Monday) on the accuracy of reported intake, 2) the accuracy of school breakfast and lunch recalls using in-person interviews compared to telephone interviews, 3) if reverse or forward reporting order affected the accuracy of recalls of school breakfast and school lunch, and 4) the effect of recency on the accuracy of dietary reports (same day, next day and Monday).

[7] Correspondence rate = (the sum of corresponding amounts from matches/reference amount) x 100; this is the proportion of the reference amount to which the reported amount corresponds, and is a true measure of accuracy. A correspondence rate is between 0% (indicating nothing reported eaten was actually consumed) and 100% (indicating all reported items were actually consumed and amounts were reported correctly).

In regards to recency, same-day recalls were conducted within 90 minutes of eating lunch, the next-day, or after a weekend. Reported intake was compared to observed lunch intake (35). Rates for matched, phantom (intrusions), and omitted foods were 84%, 5%, and 16% for same-day recalls; 68%, 13%, and 32% for next-day recalls; and for Monday recalls, 38%, 48%, and 62%. The findings indicated that children can accurately report foods eaten with limited time interval between intake and recall. Overall, the lowest omitted food rates were for beverages, followed by entrees, while the highest omission rates were for miscellaneous (non-school lunch items) and condiments. In regard to reporting amounts, there were no significant or interactive effects based on gender, ethnicity, or time interval (35).

For the 24-hour recall study utilizing telephone or in-person interview, a sample of 69 children were stratified and enrolled for equality in race (black or white) and gender, then randomly assigned to intervention groups (31). Several methods were combined to determine a total day's intake, children were observed at school breakfast and school lunch and interviews were conducted by phone that evening using the multiple-pass protocol to obtain information about that day's dietary intake, or in-person the following morning. In-person recalls compared to observed intakes for school breakfast and school lunch had mean omission rates, mean intrusion rates, and a mean total inaccuracy of 34%, 19%, and 4.6 servings, while telephone recalls were 32%, 16%, and 4.3 servings (31).

Secondary analysis of this study was also performed by comparing the two analytic methods: conventional and reporting-error-sensitive (38). The in-person and telephone interview groups were compared. The study found conventional report rates

and correspondence rates for energy and macronutrients were not significantly different ($p > 0.14$); therefore data from the two groups was combined for subsequent analyses. Median conventional report rates for energy and the macronutrients compared to median reference amounts ranged from 76%-95%. The median correspondence rates ranged from 67-79%, and inflation ratios[8] were between 7% and 17%. This indicates that conventional analysis overestimates the accuracy of children's self-reports of dietary intake and significantly differed from reporting-error-sensitive analysis ($p < 0.021$) (38).

Baxter et al (2003) investigated reverse vs. forward order reporting in elementary age children (n=121). Children were observed at school breakfast and school lunch and then each child was interviewed twice, once per order (reverse-most recent to past, forward-past to most recent) regarding what was consumed the previous day (37). The two interviews for each child were separated by at least 4 weeks and used a multiple-pass protocol. Results for reverse order recalls had a total mean omission rate of 57%, intrusion rate of 32% and a total inaccuracy of 6.4 servings. Forward order recalls had a mean omission rate of 56%, intrusion rate of 39% and a 6.9 total serving inaccuracy. Mixed model ANOVA showed no significant effects of interviewer, weekday, sequence (first or second recall), or race on omission rates, intrusion rate, or total inaccuracy. Overall there was no significant main effect for reverse vs. forward order. However, when gender was examined separately, there was a significant effect by order for omission rates ($p < 0.008$). For males, omission rates were lower for reverse (53%)

[8] Inflation ratio = (over-reported amount/reference amount) x 100. The inflation is a non-negative and can exceed 100%. Over-reported amounts may come from matches or from intrusions.

versus forward order (62%) and females had the opposite effect with a 53% omission rate for forward order and a 61% omission rate with reverse order (37).

Intricacies related to these findings that the reporting-error-sensitive approach was able to detect were not revealed by the conventional method. For girls, mean conventional report rates vs. correspondence rates ranged from 65%-80% vs. 43%-54% with forward order recalls and 55%-71% vs. 35-42% with reverse order recalls, respectively. Boys conventional report rates vs. correspondence rates ranged from 67%-82% vs. 38%-46% with forward order recalls and 62-73% vs. 43%-53% with reverse order recalls, respectively (33). Conventional report rates were significantly higher for the first than second interview for mean energy, protein, and carbohydrate ($p \leq 0.049$), but were unrelated to recall order. Only sex-order recall interactions were significant with correspondence rates higher for girls with forward-order recalls, but higher for boys with reverse-order recalls ($p \leq 0.041$). Inflation ratios were lower with reverse order than for forward order reporting for mean energy, carbohydrate, and fat ($p \leq 0.045$). Mean inflation ratios ranged from 27%-35% with forward-order and 18%-25% with reverse-order recalls. Therefore, conventional analysis overestimated reporting accuracy and did not detect order prompt and sex interactions (33).

Researchers found that the recency of a 24-hour recall affects a child's ability to recall their intake (34). Sixty randomly selected children were observed eating two school meals (breakfast and lunch) then interviewed to obtain a 24-hour recall. Previous day was defined as midnight to midnight of the day prior to the interview, while prior 24 hours was determined from the time of the interview. Three interview times (morning, afternoon, or evening) were conducted. Accuracy of foods reported at school meals for

each 24-hour recall was assessed by comparing children's reported intake to observed intake. Morning and afternoon interviews were conducted in person while evening interviews were conducted by telephone. Rates for omission and intrusion were calculated via a weighted system to determine accuracy for reporting items (34).

Reporting accuracy for the prior 24 hours was significantly more accurate than for the previous day. For omission rate, means for the prior 24 hours and the previous day were 47% ± 31, and 67% ± 25 respectively ($p=0.006$). The mean intrusion rates were 29% ± 26 for the prior 24 hours and 54% ± 23 for the previous day ($p < 0.001$). The respective means for total inaccuracy were 5.5 ± 2.9 servings and 8.6 ± 2.9 servings ($p < 0.001$) (34).

CHAPTER THREE: RESEARCH METHODOLOGY

Research Aims and Hypothesis

The purpose of the study was to determine which dietary assessment method, the 24-hour recall or the food record, would yield data that equates the greatest to the Spears Point-of Sale-Dietary-Assessment-Tool (Spears POS-DAT) in a sample of fourth and fifth grade Hispanic children. The second purpose of the study was to determine which analysis method, the conventional approach or the reporting-error-sensitive approach, accurately reflected a child's reported dietary intake determined by 24-hour recall or food records in comparison to the Spears POS-DAT.

The literature would suggest that food records compared to 24-hour recalls would exhibit the highest degree of agreement to the Spears POS-DAT and that the reporting-error-sensitive method of analysis would provide greater accuracy of dietary intake when compared to the conventional method of analysis.

Study Design

A descriptive, quantitative study was conducted. Fourth and fifth grade children reported what they had eaten at school lunch using 24-hour recall and food record dietary assessment methods. Reported dietary intake was compared to the "actual" consumption determined by the Spears Point-of-Sale-Dietary-Assessment-Tool (Spears POS-DAT), a weighed dietary assessment tool developed at the USDA, Agricultural Research Service, Beltsville Human Nutrition Research Center. Two methods to analyze the difference between actual and reported intake, conventional and reporting-error-sensitive, were examined. The data was gathered as part of the evaluation component for the Nutrition in the Garden: Grow Yourself Healthy Program during its initial year (SY 2006-2007) of

implementation. The goal of the Nutrition in the Garden: Grow Yourself Healthy Program was to improve nutrition knowledge and health behaviors of at-risk elementary school students by incorporating a nutrition curriculum within a school garden. The nutrition curriculum consisted of 12 lessons on nutrition that incorporated classroom and garden-based educational components. The University of Nevada, Reno Social Behavioral Institutional Review Board, the Washoe County School District, and the School's Board of Directors approved the Nutrition in the Garden: Grow Yourself Healthy Program. The school principal allowed participation in the Nutrition in the Garden: Grow Yourself Healthy Program (Appendix A).

The impact of the Nutrition in the Garden: Grow Yourself Healthy Program was assessed by evaluating changes in: physical activity using pedometers, nutrition knowledge using a questionnaire, and dietary intake using 24-hour recall, food records, and the Spears POS-Dat. This study will be using the dietary intake data. The baseline data collection period was in January of 2007. In May of 2007, after completion of the Nutrition in the Garden: Grow Yourself Healthy Program, data was again collected following the procedures established at baseline. Due to recovery difficulties from the Spears POS-DAT during initial data collection, values from May 2007 were used in this study.

Subjects

Fourth and fifth grade students enrolled during the 2006/2007 school year at a local charter elementary school were invited to participate in the study. The school's enrollment is 95% Hispanic, of whom 91% speak English as a second language. Eighty-two percent of students are eligible to receive free or reduced price school meals, which

is an indicator of low economic status. To be included in the study children had to be enrolled as a fourth or fifth grade student at the time the study started in January 2007. Exclusion criteria consisted of parents returning a form stating they did not want their child participating in the study and/or a child declining to participate.

Subject Recruitment and Informed Consent

In the fall of 2006, study investigators met with the teachers and school staff involved with the Nutrition in the Garden: Grow Yourself Healthy Program in which the goals, procedures, and timeline for the study were presented. The curriculum, teaching materials, survey instrument, the consent, assent and permission process, and forms were also reviewed. In January 2007, approximately two weeks prior to the beginning of the study, an investigator provided each student with a letter to take home to their parent or guardian (Appendix B and C). The parental information letter described the study, the procedures to protect the students' confidentiality, and provided phone numbers for the study investigators and the University of Nevada, Reno Social Behavioral Institutional Review Board. Parents who did not want their child to participate in the study were instructed to return the information letter provided by a specified date. The parental information letter was sent home in both English and Spanish. A script was read to the students by an investigator describing the study. The voluntary nature of the program was emphasized.

Data Collection Procedures

Data was used from information gathered in the first year of the Nutrition in the Garden: Grow Yourself Healthy Program at a local charter elementary school. For two weeks the Spears POS-DAT values were obtained at lunch to determine the actual

amount of foods eaten. During this time, fourth and fifth students enrolled in the study kept a 3-day food record (Appendix D and E) and were interviewed by University of Nevada, Reno students to obtain a single day 24-hour recall. Since only school lunch was offered, 3-day food records and 24-hour recalls were only analyzed for items eaten at lunch in this study.

Food Records

Students were instructed on how to complete a 3-day food record the Friday prior to starting the study. They were engaged in activities to introduce the concepts of measuring and portion size. The students were sent home with the measuring cups and spoons so that they could use them when filling out their food records when not at school.

The following week, each child was given a food diary booklet, which included written instructions (in English and Spanish), a sample day, 3 daily sheets for recording their intake, along with questions about fruit and vegetable consumption. In addition, aserving size estimation chart (in case their measuring utensils were unavailable) and a letter to the parents (with instructions on assisting with the food record at home) were included. This booklet was reviewed by an investigator with each class, emphasizing specifics on types and amounts of food. The students began recording in their diaries on Tuesday or Wednesday to avoid weekend days.

24-Hour Recall

Twenty-four hour recalls were conducted on the second or third day during the same period when both food records and Spears POS-DAT data collection occurred. The 24-hour recall interviews were conducted by dietitians or University of Nevada, Reno nutrition students. Interviewers were instructed on how to conduct a 24-hour recall and

written guidelines were also provided. MyPyramid.gov tracker was used to conduct and record the 24-hour recall. The food items and amounts reported at lunch were also recorded in a log book since the MyPyramid tracker does not distinguish between foods eaten at different times. A multiple pass method was utilized in which each child was asked to name everything eaten during the previous day. The interviewer then reviewed all foods identified from the previous day and asked if there was anything else that they had previously forgotten, if so those foods and amounts were then added. After all items were entered into the computer, the child was then asked to estimate portion sizes of the foods recalled. Measuring cups and spoons, and various sizes of bowls, plates and glasses were available to assist with portion size estimations. The lunch portion of the 24-hour recall was used in this study.

Spears Point-of-Sale-Dietary-Assessment-Tool (Spears POS-DAT)

Lunch food intake by the Spears POS-DAT was collected for two weeks for those children enrolled in the study. The food record and the 24-hour recall data were obtained during this time period. This school participated in the Universal Free Meal Program (39). Each student in the study who selected school lunch that day was given an identification tag with an identifier barcode. Students with a barcode identification tag picked up a pre-barcoded tray. After students had selected their foods from the cafeteria, the barcode on the identification tag was scanned using the Metrologic MS3780 Fusion™ Barcode scanner along with the tray barcode so that the tray chosen was then matched to that child. Only the investigators were aware of the match. Each food item was then scanned prior to the child sitting down for lunch. If food items had a standard weight they were not weighed prior to consumption. Those items determined to have a large

variability in their weights were weighed at check out using the Mettler-Toledo balance scale (Model # XS4001S, Columbus, Ohio) attached to the computer. After the students sat down to eat, an investigator observed the entire lunch period to account for any trading of foods or requests for additional food items. A paper tent with the tray number was placed visibly on the trays so that the observer could record tray numbers. At this school students who brought lunch from home commonly sat at separate tables so foods shared from home were very minimal. After the children finished lunch, they placed their trays on a rack. When the lunch period was over, all food items remaining on the trays were weighed so that actual amounts consumed could be calculated. This was done by scanning the tray number and then weighing all foods that remained on the tray. If the entire item had been eaten it was not weighed and assumed eaten in entirety.

Data Analyses Methods

Conventional and reporting-error-sensitive methods of analysis were conducted and compared. Table 1 defines the pertinent terminology.

Table 1. Definition of Terms

Conventional Report Rate	The ratio of the reported to the reference amount of energy or a nutrient. For an individual, report rate = (reported amount/reference amount) x 100. It has a lower bound of 0% (which indicates nothing was reported), but no upper bound (because there is no limit on what an individual can report). Conventionally, values close to 100% are interpreted as indicating high accuracy, <100% under-reporting, and > 100% over-reporting.
Correspondence rate	The percentage of the reference amount to which the reported amount corresponds. For an individual, correspondence rate = (corresponding amount from matches/reference amount) x 100. It has a lower bound of 0%, which indicates that nothing in the reference set was reported eaten and an upper bound of 100%, which indicates that all items and amounts in the reference set were reported correctly. Higher correspondence rates reflect better reporting accuracy.
Corresponding amount	The amount of a match that correctly corresponds to the reference amount.
Intrusion	A food item that is not eaten, but is reported eaten.
Match	A food item that is actually eaten and is reported eaten.
Omission	A food item that is actually eaten but is not reported eaten.
Over-reported amount	The amount by which the reported amount of a match exceeds the reference amount, or the amount of an intrusion.
Reference amount	The amount of a food item in the reference set, measured in grams and converted to energy or nutrients.
Reference information	The set of food items (reference set) and their amounts that were actually eaten by a study participant, obtained from the Spears POS-DAT.
Reported amount	The amount of a food item the participant reports eating.
Unreported amount	The amount by which the reported amount of a match falls short of the reference amount, or the amount of an omission.

Adapted from (32, 38)

Conventional Method

The children's reported intake from food records and 24-hour recalls were entered into the Nutritionist Pro Version 3.2 (Axxya Systems, Stafford, TX) database to obtain information concerning energy and macronutrients. Reference amounts for energy, protein, carbohydrate, and fat were also obtained by entering the gram weight obtained from the Spears POS-DAT into the Nutritionist Pro database. For items not found in the Nutritionist Pro database, Sodexo, the school district's food management company, provided nutrition information which was then entered into the Nutritionist Pro database. Mean energy and macronutrient values were calculated for food records, 24-hour recalls, and the Spears POS-DAT intake.

A report rate was calculated for each child for their 24-hour recall and food record. The report rate is the reported percentage of the reference amount ([total reported amount/total reference amount] x100). Values that are close to 100% indicate a high reporting accuracy, values <100% indicate underreporting and values >100% indicate over-reporting.

Reporting-Error-Sensitive Method

For each child, each reference item was classified as a match or as an omission, and each reported item was classified as a match or as an intrusion. After each item was classified as a match, omission or intrusion, the amount of energy and macronutrients for each item were classified as corresponding, over-reported or unreported. To be classified as a match (for item and amount), the reported gram weight had to be ±15% of the actual gram weight determined by the Spears POS-DAT. If the item was a match for the item, but not the amount, the reported gram weight was subtracted from the actual gram weight

to obtain the over-reported or unreported amounts. Total energy (in kcal) and total grams of each macronutrient were calculated for each lunch period. An average of the lunches (reported and referenced) in each child's food record were also calculated. Table 2 shows how these variables were calculated for energy for one child.

A correspondence rate, which is a measure of reporting accuracy that is sensitive to reporting errors was calculated for energy and each macronutrient for each child for each school lunch period. The correspondence rate [(corresponding amount from matches/reference amount) x 100] is the percentage of the reference amount that is reported correctly. A correspondence rate of 0% would indicate that nothing observed eaten was reported, and a 100% correspondence rate would indicate that all observed items and amounts were reported correctly.

Table 2. Classifications and calculations used to assess the accuracy of reported energy compared with reference energy for one child.[a]

Food Item	Reported amount (grams)	Reference amount (grams)	Reported kcal	Reference kcal	Over-reported kcal from intrusions[b]	Over-reported kcal from matches[c]	Corresponding kcal from matches[d]	Unreported kcal from matches[e]	Unreported kcal from omissions[f]
Pizza stick	88.6	88.6	230	230	0	0	230	0	0
Baby carrots	0.0	25.4	0	9	0	0	0	0	9
Milk, 1% strawberry	248.5	106.6	103	45	0	58	45	0	0
Apple	47.6	127.0	25	66	0	0	25	41	0
Ranch dressing	28.0	0.0	136	0	136	0	0	0	0
Total			494	350	136	58	300	41	9

[a]Reference information was obtained by the Spears POS-DAT. At lunch the recorded intake for this child was pizza stick, baby carrots, strawberry milk, and an apple. The child reported eating pizza stick, strawberry milk, apple, and ranch dressing.

[b]Over-reported kcal from intrusions = kcal from intrusions (i.e. food items reported eaten but not in reference set).

[c]Over-reported kcal from matches = for matches for which reported kcal > reference kcal, absolute differences between reported kcal and reference kcal.

[d]Corresponding kcal from matches = for matches, overlap between reported kcal and reference kcal.

[e]Unreported kcal from matches = for matches for which reported kcal < reference kcal, absolute differences between reported kcal and reference kcal.

[f]Unreported kcal from omissions = kcal from omission (i.e. food items in reference set but not reported eaten).

Statistical Analysis

All statistical analysis was performed on SPSS Version 15.0 for Windows (SPSS Inc, Chicago, IL). Unless indicated, a p-value of ≤ 0.05 was used to determine significance.

Conventional Method

Descriptive statistics were calculated for reported and reference intake for 24-hour recall and food record dietary assessment methods. Paired *t*-tests were used to compare the mean differences between reported intake by food records (2-3 day mean) and 24-hour recalls compared to referenced amounts for energy, protein, carbohydrate, and fat. Report rates were also calculated for 24-hour recalls and food records.

Reporting-Error-Sensitive Method

Descriptive statistics were calculated for energy and macronutrients in five categories: over-reported amounts from intrusions, over-reported amounts from matches, corresponding amounts from matches, unreported amounts from matches, and unreported amounts from omissions for 24-hour recalls and food records. Paired *t*-tests were used to compare the mean between reference and reported amounts compared with corresponding amounts from matches for 24-hour recalls and food records. Correspondence rates were also calculated for 24-hour recall and food record dietary assessment methods.

CHAPTER FOUR: RESULTS

Demographic Characteristics

A total of 40 participants were eligible for this study; 33 completed 24-hour recalls and a different 33 of the 40 completed food records (26 completed both 24-hour recalls and food records, while 7 completed only a 24-hour recall or a food record). Of the 33 completed food records, 2-day records were available for 10 participants, while the remaining 23 completed 3-day records. Demographic characteristics of the sample are shown in Table 3. The sample had almost an equal distribution of males and females. The subjects were part of the fourth and fifth grade classes at a local charter elementary school, with the distribution of ages appropriate for those classes. The ethnic background of the sample was consistent with the enrollment at this school.

Table 3. Demographic Characteristics (n=40)

		n	%
Gender	Male	21	53
	Female	19	48
Age	9 yrs. old	10	25
	10 yrs. old	20	50
	11 yrs. old	10	25
Race	Hispanic	37	93
	Caucasian	1	2.5
	American Indian	1	2.5
	Native Hawaiian/Pacific Islander	1	2.5

Conventional Approach

Table 4 shows the results from the conventional approach for analyzing energy and macronutrients with the use of 24-hour recalls and food records. Mean reported intake was compared to the mean reference intake using paired *t*-tests for 24 hour recalls and found significant differences for grams of protein (p=0.04) and grams of carbohydrate (p=0.05). No significant differences were found when comparing the mean reported intake and the mean reference intake of food records in any category (kcal, protein, carbohydrate, or fat). Pearson correlations between reference and reported amounts for 24-hour recalls and food records were significant for energy and each macronutrient ranging from 0.40 to 0.67 (all p-values < 0.05) and 0.45 to 0.68 (all p-values < 0.01), respectively.

Conventional report rates are shown in Table 8. For 24 hour recalls, the report rates for energy and macronutrients ranged from 124% to 131%, indicating consistent over-reporting. Food record report rates ranged from 95% to 112%.

Table 4. Results from the conventional approach for analyzing energy and macronutrients (n=33)

							Statistical Test			
Energy/ macronutrient	Reference[a] Mean (SD[b])	SEM[c]	Reference Range	Reported Intake Mean (SD[b])	SEM[c]	Reported Intake Range	Paired *t*-tests	p-value	Pearson Correlations	p-value
RECALL										
Kilocalories	467 (160)	NA	128-785	552 (312)	NA	160-1461	-1.746	0.09	0.45	0.009
Protein (g)	16 (5)	NA	5.0-28	20 (10)	NA	4.0-49	-2.188	0.04	0.43	0.01
Carbohydrate (g)	57 (22)	NA	19-121	66 (33)	NA	19-150	-2.039	0.05	0.67	<0.001
Fat (g)	20 (10)	NA	4.0-43	24 (24)	NA	1-132	-0.992	0.33	0.40	0.02
FOOD RECORD										
Kilocalories	480 (110)	19.6	311-754	473 (158)	27.57	269-1025	0.319	0.75	0.60	<0.001
Protein (g)	17 (4)	0.74	10.0-29	18 (5)	0.92	10.0-37	-1.840	0.08	0.50	0.003
Carbohydrate (g)	63 (16)	2.82	24-102	59 (23)	4.04	26-123	1.176	0.25	0.68	<0.001
Fat (g)	20 (10)	1.72	7.0-60	20 (9)	1.55	9.0-50	0.355	0.73	0.45	0.009

[a]Reference information was obtained by the Spears POS-DAT

[b]SD=standard deviation

[c]Standard Error of the Mean for mean of 2-3 day food records

NA=not applicable

Reporting-Error-Sensitive Approach

Table 5 shows descriptive statistics for energy and macronutrients for the five categories of amounts used to calculate variables for the reporting-error-sensitive approach compared with the mean reference and reported amounts for 24-hour recalls and food records. These values indicate that corresponding amounts from matches for different nutrients constituted only part of the reported amounts, and that over-reported amounts and unreported amounts were not consistent.

Table 5. Descriptive statistics for amounts of energy and macronutrient according to reference, reported, and five categories of amounts given as mean (standard deviation)(n=33)

	Reference[a]	Reported	Over-reported amount from intrusions	Over-reported amounts from matches	Corresponding amount from matches	Unreported amount from matches	Unreported amount from omissions
RECALL							
Kilocalories	467 (160)	552 (312)	137 (165)	111 (192)	290 (183)	23 (43)	146 (180)
Protein (g)	16 (5)	20 (10)	6 (7)	3 (5)	11 (7)	0.3 (0.9)	5 (7)
Carbohydrate (g)	57 (22)	66 (33)	17 (22)	11 (15)	37 (26)	1 (3)	19 (21)
Fat (g)	20 (10)	24 (24)	5 (7)	7 (17)	12 (9)	2 (4)	7 (9)
FOOD RECORD							
Kilocalories	480 (110)	473 (158)	137 (140)	135 (136)	293 (95)	70 (79)	166 (95)
Protein (g)	17 (4)	18 (5)	6 (7)	5 (5)	11 (4)	3 (3)	6 (7)
Carbohydrate (g)	63 (16)	59 (23)	15 (15)	16 (21)	37 (11)	9 (9)	24 (13)
Fat (g)	20 (10)	20 (9)	6 (7)	6 (6)	11 (6)	3 (4)	7 (6)

[a]Reference information was obtained by the Spears POS-DAT.

Tables 6 and 7 compare the mean reference and mean reported or recalled nutrient values to the values obtained when analyzing the mean corresponding amounts from matches. Significant differences ($p \leq 0.001$) were found for 24-hour recalls and food records for energy and each macronutrient when comparing the corresponding item and amount match category using paired *t*-tests.

Table 6. Comparisons of reference and recalled amounts for energy and macronutrients to corresponding amounts from matches for 24-hour recalls given as mean and (standard deviation)(n=33).

Energy/ macronutrient	POS-DAT Reference[a] Mean (SD)	Mean Corresponding amounts from matches (SD)	Paired *t*-tests	p-value	Pearson Correlations	p-value
RECALL						
Kilocalories	467 (160)	290 (183)	-5.670	<0.001	0.47	0.006
Protein (g)	16 (5)	11 (7)	-4.629	<0.001	0.40	0.02
Carbohydrate (g)	57 (22)	37 (26)	-5.675	<0.001	0.64	<0.001
Fat (g)	20 (10)	12 (9)	-5.127	<0.001	0.50	0.003

[a]Reference information was obtained by the Spears POS-DAT.

Table 7. Comparisons of reference and reported amounts for energy and macronutrients to corresponding amounts from matches using food records given as mean and (standard deviation)(n=33).

Energy/ macronutrient	POS-DAT Reference[a] Mean (SD)	Mean Corresponding amounts from matches (SD)	Paired *t*-tests	p-value	Pearson Correlations	p-value
FOOD RECORD						
Kilocalories	480 (110)	293 (95)	-10.242	<0.001	0.50	0.005
Protein (g)	17 (4)	11 (4)	-7.850	<0.001	0.49	0.004
Carbohydrate (g)	63 (16)	37 (11)	-10.351	<0.001	0.53	0.001
Fat (g)	20 (10)	11 (6)	-6.002	<0.001	0.51	0.003

[a]Reference information was obtained by the Spears POS-DAT.

Correspondence rates are shown in Table 8. Twenty-four hour recalls had correspondence rates ranging from 61% to 67% while the food records correspondence rates ranged from 60%-67% for kilocalories, protein, carbohydrate, and fat.

Table 8. Descriptive statistics for convention report rates and correspondence rates for energy and macronutrients given as mean (standard deviation)(n=33)

	Conventional Report Rate[a]	Report Rate Range	Correspondence Rate[b]	Correspondence Rate Range
RECALL				
Kilocalories	124% (64)	33-308	63% (33)	0-100
Protein (g)	127% (60)	22-287	67% (36)	0-100
Carbohydrate (g)	121% (56)	42-337	65% (33)	0-100
Fat (g)	131% (96)	5-366	61% (35)	0-100
FOOD RECORD				
Kilocalories	99% (25)	58-178	62% (19)	23-93
Protein (g)	112% (29)	63-201	67% (23)	18-99
Carbohydrate (g)	95% (25)	42-158	61% (18)	29-89
Fat (g)	105% (41)	39-199	60% (26)	13-100

[a]Conventional report rate = (reported amount/reference amount) x 100. A report rate has a lower bound of 0% (which indicates nothing was reported), but no upper bound (because there is no limit on what an individual can report).

[b]Correspondence rate = (corresponding amount/reference amount) x 100; this is the proportion of the reference amount to which the reported amount corresponds, and is a true measure of accuracy. A correspondence rate is between 0% (indicating nothing reported eaten was actually consumed) and 100% (indicating all reported items were actually consumed and amounts were reported correctly).

CHAPTER FIVE: DISCUSSION AND CONCLUSIONS

The accuracy in which fourth and fifth graders reported dietary intake by 24-hour recalls or food records varied depending on the analysis method used.

Conventional Analysis Approach

For 24-hour recalls, conventional energy and macronutrient intake analysis indicated that subjects were fairly accurate in their ability to recall the foods and beverages consumed at school lunch the previous day (Table 4). Significant differences between mean reference and recalled intakes were found only for protein and carbohydrate. For protein intake, the mean reference value was 16 ± 5 grams and mean recalled value was 20 ± 10 grams ($p=0.04$); carbohydrate mean reference intake was 57 ± 22 grams compared to mean 24-hour recall intake of 66 ± 33 grams ($p=0.05$). Mean reference energy intake was 467 ± 160 kcals compared to mean 24-hour reported energy intake of 552 ±312 kcals; however, this difference was not significant ($p=0.09$). Pearson correlations were significant for energy and each macronutrient ranging from 0.40 to 0.67, indicating a moderate correlation (Table 6).

Based on conventional analysis, the food record dietary intake assessment method showed greater accuracy than the 24-hour recall method (Table 4). No significant differences between mean reference and mean food record reported energy and macronutrient intakes were observed; while the 24-hour recall dietary assessment method exhibited significant differences in measured and reported mean protein and carbohydrate intake. Pearson correlations for food records were slightly higher than for 24-hour recalls (kcals 0.60 vs. 0.45, protein 0.50 vs. 0.43, carbohydrates 0.68 vs. 0.67, and fat 0.45 vs.

0.40) (Table 4). These findings support what Crawford et al found, that food records had the greatest degree of agreement to reference criteria (26).

The mean conventional report rates for energy and macronutrients were high for 24-hour recalls ranging from 121% to 131% indicating consistent over-reporting. The conventional report rates for food records were closer to 100%, ranging from 95% to 112% and with smaller standard deviations, which indicates greater accuracy.

Using the conventional method of analysis, over-reporting of school lunch intake found in this study were consistent with some, (10, 27) but not all (25, 32, 33, 38) previous 24-hour recall validation studies; which found under-reporting prevalent among children. Similar to our findings, two studies found significant over-reporting. It is interesting to note that in both studies, a subject's 24-hour dietary recall was assisted by a non-quantified food record. Third grade children over-reported energy consumption in the CATCH study (10) and energy plus the number of servings of fruits and number of servings of fruits and vegetables were over-reported in the Recall Validation Study of fourth graders (27).

In contrast, Carter et al found 10-12 year-olds attending summer camp under-reported their intake compared to observed intake (25). Similar findings to Carter et al were observed in three other 24-hour recall studies (32, 33, 38), in which significant under-reported amounts for energy and macronutrients among fourth graders were observed.

This study found a significant difference between 24-hour recall and the Spears POS-DAT measured mean intake for protein and carbohydrates; yet a study conducted by Crawford, et al found no significant differences between reported and observed mean

values for energy or any of the macronutrients among 9 and 10 year old girls (26). However, for 3-day food record reported intake, the Crawford et al study was in agreement with the current study's findings, that no significant differences were found for reported and observed or measured energy or macronutrients mean intake (26).

Correlation coefficients found in this study between 24-hour recalls and the Spears POS-DAT mean intake (0.40 to 0.68) (Table 4) were within the range observed by Smith et al, who reported correlations for energy and macronutrients that ranged from 0.52 to 0.63 when comparing fourth graders 24-hour recalls to observed intake at school lunch (38). Slightly lower correlation coefficient ranges were found in Baxter et al's studies. Using multiple 24-hour recalls, Baxter and colleagues found correlations ranging from 0.27 to 0.53 for energy and each macronutrient in relation to observed average intake (32). Similar correlation ranges (0.28 to 0.57) were found when comparing the accuracy of children's dietary reports and the effect of order prompts in 24-hour recalls (33). The lower correlation coefficients may be due to the variation in 24-hour recall protocol used by Baxter and colleagues and that performed by this study.

In contrast to this study's findings, Emmons and Hayes found slightly higher significant correlations for both kcal (0.49 vs. 0.45 in this study) and protein (0.58 vs. 0.43 in this study) in third graders comparing 24-hour recalls to observed mean intakes. Furthermore, in fourth graders, higher correlation coefficients, indicating a strong linear relationship, were demonstrated (0.77 for kcal and 0.82 for protein) (24).

One previous study explored the relationship between mean 24-hour recall and mean 3-day food records compared to observed intake. Crawford et al had a correlation coefficient range of 0.46 for carbohydrate to 0.79 for saturated fat using recalls, with

higher correlations in the 3-day record group ranging from 0.78 for carbohydrate to 0.94 for protein (26). The higher correlations for the 3-day food record group may be a result of subjects recording their food intake soon after eating, thus decreasing the reliance on memory as compared with the 24-hour recall.

The only other study to examine food records in children compared a weekly monitoring approach to a daily monitoring approach validated with observation. Correlations ranged widely from 0.16 to 0.85 and were significant for eight of nine meal items for the daily monitoring approach. The weekly monitoring approach ranged from -0.21 to 0.69 and was significant for three of nine meal items. Under-reporting was more common than over-reporting (28).

Reporting-Error-Sensitive Approach

The reporting-error-sensitive analysis approach indicated that children were unable to report their food intake accurately using food records or 24-hour recalls. The high incidence of intrusions and omissions as well as unreported or over-reported amounts from matches for energy and macronutrients found using the reporting-error-sensitive analysis approach were not reflected in the conventional analysis of 24-hour recall and food records. For matches, when comparing the mean corresponding amounts (correctly reported parts of reference amounts) to the Spears POS-DAT reference mean using paired *t*-tests, significant differences for energy and all macronutrients occurred for 24-hour recalls as well as for food records (all p-values < 0.001) (Tables 6 and 7) .

The reporting-error-sensitive correspondence rates and conventional report rate ranges were, 61% to 67% and 121% to 131% for 24-hour recalls and from 60% to 67% and 95% to 112% for food records, respectively. This indicates that correctly recalled or

reported amounts compared to reference amounts were substantially lower than what was indicated by conventional analysis.

Reporting-error-sensitive Pearson correlation coefficients (0.40-0.64) evaluated the relationship between mean reference amounts and mean corresponding amounts from matches, whereas conventional analysis (0.40-0.68) evaluated mean reference amounts in relation to mean reported amounts for 24-hour recalls and food records. Even though different measures were compared, similar correlation coefficients were identified (Tables 4, 6 and 7). Based on Pearson correlations, reporting-error-sensitive and conventional analysis approaches did not differ; yet it has been documented that correlation coefficients do not indicate the full relationship between two variables (40). Previous studies using the reporting-error-sensitive approach did not include correlation coefficients in their findings.

This study is unique; it evaluated both 24-hour recalls and food records, while others examined only 24-hour recalls. Therefore, comparing this study's results to previous studies finding is limited to 24-hour recall.

In contrast to the current findings, prior studies found under-reporting rather than over-reporting was prevalent. For example, Baxter et al examined the effect of order prompts on the accuracy of school breakfast and lunch intake recalled 24-hour later. Conventional mean nutrient report rates were consistently higher than reporting-error-sensitive correspondence rates. Overall, conventional report rates ranged from 55% to 82% while correspondence rates ranged from 35% to 54% (33).

Smith et al compared conventional intake accuracy from school breakfast and school lunch to the reporting-error-sensitive method for accuracy. They conducted 24-

hour recall interviews in children by telephone or in-person. Mean conventional report rates ranged from 76% to 95% while mean correspondence rates ranged from 67% to 79% (38).

Another study compared the two dietary intake analysis methods using multiple 24-hour recalls in children. Again mean conventional report rates for energy and macronutrients were high, ranging from 80-101% suggesting high reporting accuracy by conventional standards and they did not vary over interviews. Correspondence rates were lower ranging from 39% to 61%, however correspondence rates increased significantly between the first and second interview indicating that reporting accuracy improved over time. This was not detected by conventional analysis (32).

Each of these studies found significant differences by conventional analysis between mean observed and mean recalled amounts for energy, protein, carbohydrate and fats, with recalled amounts less than observed. Yet, the researchers did not conduct statistical tests, such as paired *t*-tests, to determine if the differences between conventional report rates and correspondence rates were statistically significant.

In this study paired *t*-tests found significant differences for energy and macronutrients between reference amounts and corresponding amounts from matches using 24-hour recalls and food records. In addition, correspondence rates vs. conventional report rates resulted in substantial differences. The reporting-error-sensitive analysis approach provided additional information on reporting accuracy and therefore may be a better indicator of how children report dietary intake than the conventional analysis method. However, Pearson correlations were similar for conventional analysis and the reporting-error-sensitive analysis approach. Some uncertainty remains whether

food records are more valid methods for assessing intake among fourth and fifth graders since the reporting-error-sensitive analysis did not support the findings of the conventional approach.

Strengths and Limitations

An important strength of this study was the use of the Spears POS-DAT to validate children's self reports of dietary intake. This method was recently validated against observation. Historically, comparisons between reported intake and reference criteria have been by direct observation. The Spears POS-DAT directly measure intake avoiding interobserver reliability error documented with direct observation (41).

Another strength is that two different methods of obtaining reported dietary intake were used: the 24-hour recall and the food record. In addition, two analytic approaches were used for validation: conventional analysis and reporting-error-sensitive analysis. This is the first study to include 24-hour recalls and food records while using the reporting-error-sensitive analysis approach.

However, there are some limitations to this study. First, the study enrolled only fourth and fifth grade students from a low income, charter elementary school that enrolled mostly Hispanic children; therefore the study findings may not be generalized to other populations. Second, analyses were limited to children who obtained lunch from the school food service. The children who brought lunch from home were not included in the study.

The study design may have affected the conclusion regarding which dietary assessment method, the 24-hour recall or the food record capture "true" intake in children. The school lunch used a rotating menu; therefore it may have been easier for

the children to remember school lunch items, leading to an increase in children's ability to recall lunch intake. However, this method of validation was used in prior studies. Due to a difficulty in retrieving January 2007 data from the Spears POS-DAT, baseline data were not included in the study. It is possible that children may have improved their ability to recall or record their dietary intake with practice (32, 36). Because some children were absent during the 3-day food record data collection, only 2-day food records rather than 3-day food records were used in some cases. This may have introduced participation bias.

Conclusions

Results from this study indicate that in fourth and fifth grade students, food records are more accurate than 24-hour recalls in dietary intake assessment based on conventional analysis. In addition, findings suggest that the reporting-error-sensitive analysis approach contributes to the validation of reported dietary assessment and is possibly better than the conventional analysis approach in children.

Unlike the conventional analysis approach, the reporting-error-sensitive dietary intake analysis includes omissions, intrusions and incorrect reported amounts for matched items. Based on study results, the reporting-error-sensitive dietary intake analysis approach more accurately reflected the difference between reference dietary intakes and reported dietary intake values.

In this study, the conventional analysis approach indicated that children were able to generally to recall the energy and macronutrients they ate accurately using 24-hour recalls and food records. In addition, the study found that food records had a higher degree of reporting accuracy than 24-hour recalls. Mean Spears POS-DAT and mean

food record nutrient intakes did not significantly differ. Based on conventional report rates, there was substantial over-reporting with 24-hour recalls while food records had ranges closer to 100%.

Study results were different with the reporting-error-sensitive analysis approach. This analysis approach utilizes corresponding amounts from matches and correspondence rates, which take into account the energy and nutrients from items and amounts that were accurately reported rather than total mean values reported, as used in the conventional method. Corresponding mean amounts from matches compared to mean reference amounts were significantly different in all categories and for both 24-hour recalls and foods records. In addition, correspondence rates were much lower than report rates indicating a lesser degree of accuracy than what the conventional analysis revealed.

Recommendations for Future Research

Future validation studies investigating ways to enhance the way children report dietary intake should consider using the reporting-error-sensitive analysis approach.

Food records were more accurate in determining lunch intake by conventional analysis; however this was not confirmed using the reporting-error-sensitive analysis approach. Additional studies are needed to confirm this study's findings.

This study only enrolled fourth and fifth grade students primarily of Hispanic origin in a low income charter elementary school, therefore studies in different populations are needed. Further research is required to explore valid methods for reporting dietary intake among children.

REFERENCES

1. USDHHS, *The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity. 2001*, USDHHS, Public Health Service, Office of the Surgeon General: Rockville, MD.
2. USDHHS, *Chapter 19: Nutrition and Overweight, in Healthy People 2010*. 2000, U.S. Government Printing Office: Washington, D.C. p. 19-3-49.
3. Dietz, W.H., *Health consequences of obesity in youth: childhood predictors of adult disease*. Pediatrics, 1998. **101**(3 Pt 2): p. 518-25.
4. Freedman, D.S., Dietz, W.H., Srinivasan, S.R., and Berenson, G.S., *The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study*. Pediatrics, 1999. **103**(6 Pt 1): p. 1175-82.
5. Willet, W., *Nutritional Epidemiology*. Second ed. 1998, New York: Oxford University Press.
6. Hu, F.B., *Dietary pattern analysis: a new direction in nutritional epidemiology*. Curr Opin Lipidol, 2002. **13**(1): p. 3-9.
7. Kant, A.K., *Dietary patterns and health outcomes*. J Am Diet Assoc, 2004. **104**(4): p. 615-35.
8. Brunner, E.J., Mosdol, A., Witte, D.R., Martikainen, P., Stafford, M., Shipley, M.J., and Marmot, M.G., *Dietary patterns and 15-y risks of major coronary events, diabetes, and mortality*. Am J Clin Nutr, 2008. **87**(5): p. 1414-21.
9. Rutishauser, I.H., *Dietary intake measurements*. Public Health Nutr, 2005. **8**(7A): p. 1100-7.
10. Lytle, L.A., Nichaman, M.Z., Obarzanek, E., Glovsky, E., Montgomery, D., Nicklas, T., Zive, M., and Feldman, H., *Validation of 24-hour recalls assisted by food records in third-grade children*. The CATCH Collaborative Group. J Am Diet Assoc, 1993. **93**(12): p. 1431-6.
11. Spears, K., N*ew dietary assessment tool to evaluate school nutrition education programs*. Journal of Nutrition Education and Behavior, 2007. **39**(4): p. S110-S111.
12. Willett, W., *Nutritional Epidemiology*. Second ed. 1998, New York: Oxford University Press.
13. Blanton, C.A., Moshfegh, A.J., Baer, D.J., and Kretsch, M.J., The USDA *Automated Multiple-Pass Method accurately estimates group total energy and nutrient intake*. J Nutr, 2006. **136**(10): p. 2594-9.
14. Goldman, J. and Borrud, L. A*n overview of USDA's 1994-96 Continuing Survey of Food Intakes by Individuals and Diet and Health Knowledge Survey. in 1997 Proceedings of the Section on Survey Research Methods*. 1997: American Statistical Association.
15. Dolecek, T.A., Stamler, J., Caggiula, A.W., Tillotson, J.L., and Buzzard, I.M., *Methods of dietary and nutritional assessment and intervention and other methods in the Multiple Risk Factor Intervention Trial*. Am J Clin Nutr, 1997. **65**(1 Suppl): p. 196S-210S.

16. van Horn, L.V., Stumbo, P., Moag-Stahlberg, A., Obarzanek, E., Hartmuller, V.W., Farris, R.P., Kimm, S.Y., Frederick, M., Snetselaar, L., and Liu, K., The *Dietary Intervention Study in Children (DISC): dietary assessment methods for 8- to 10-year-olds*. J Am Diet Assoc, 1993. **93**(12): p. 1396-403.
17. Barrett-Connor, E., *Nutrition epidemiology: how do we know what they ate?* Am J Clin Nutr, 1991. **54**(1 Suppl): p. 182S-187S.
18. Frank, G.C., T*aking a bite out of eating behavior: food records and food recalls of children*. J Sch Health, 1991. **61**(5): p. 198-200.
19. Small, M.Y., *Cognitive Development*. 1990, San Diego: Harcourt Brace Jovanovich, Inc.
20. Baranowski, T. and Domel, S.B., *A cognitive model of children's reporting of food intake.* Am J Clin Nutr, 1994. **59**(1 Suppl): p. 212S-217S.
21. Hill, R.J. and Davies, P.S., *The validity of self-reported energy intake as determined using the doubly labelled water technique*. Br J Nutr, 2001. **85**(4): p. 415-30.
22. Livingstone, M.B. and Black, A.E., *Markers of the validity of reported energy intake*. J Nutr, 2003. **133 Suppl 3**: p. 895S-920S.
23. Meredith A, Matthews A, Zickefoose M, Weagley E, Wayave M, and Brown EG, *How well do school children recall what they have eaten?* J Am Diet Assoc, 1951. **27**: p. 749-751.
24. Emmons, L. and Hayes, M., *Accuracy of 24-hr. recalls of young children*. J Am Diet Assoc, 1973. **62**(4): p. 409-15.
25. Carter, R.L., Sharbaugh, C.O., and Stapell, C.A., *Reliability and validity of the 24-hour recall*. J Am Diet Assoc, 1981. **79**(5): p. 542-7.
26. Crawford, P.B., Obarzanek, E., Morrison, J., and Sabry, Z.I., *Comparative advantage of 3-day food records over 24-hour recall and 5-day food frequency validated by observation of 9- and 10-year-old girls*. J Am Diet Assoc, 1994. **94**(6): p. 626-30.
27. Lytle, L.A., Murray, D.M., Perry, C.L., and Eldridge, A.L., *Validating fourth-grade students' self-report of dietary intake: results from the 5 A Day Power Plus program.* J Am Diet Assoc, 1998. **98**(5): p. 570-2.
28. Domel, S.B., Baranowski, T., Leonard, S.B., Davis, H., Riley, P., and Baranowski, J., *Accuracy of fourth- and fifth-grade students' food records compared with school-lunch observations*. Am J Clin Nutr, 1994. **59**(1 Suppl): p. 218S-220S.
29. Baranowski, T., Dworkin, R., Henske, J.C., Clearman, D.R., Dunn, J.K., Nader, P.R., and Hooks, P.C., *The accuracy of children's self-reports of diet: Family Health Project*. J Am Diet Assoc, 1986. **86**(10): p. 1381-5.
30. National Institute on Child Health and Development. *National Children's Study literature review on the assessment of food and dietary supplement intakes and patterns of use in women and young children*. 2004; Available from: http://riskfactor.cancer.gov/tools/.
31. Baxter, S.D., *Accuracy of fourth-graders' dietary recalls of school breakfast and school lunch validated with observations: in-person versus telephone interviews*. J Nutr Educ Behav, 2003. **35**(3): p. 124-34.

32. Baxter, S.D., Smith, A.F., Hardin, J.W., and Nichols, M.D., *Conclusions about children's reporting accuracy for energy and macronutrients over multiple interviews depend on the analytic approach for comparing reported information to reference information.* J Am Diet Assoc, 2007. **107**(4): p. 595-604.
33. Baxter, S.D., Smith, A.F., Hardin, J.W., and Nichols, M.D., *Conventional energy and macronutrient variables distort the accuracy of children's dietary reports: illustrative data from a validation study of effect of order prompts.* Prev Med, 2007. **44**(1): p. 34-41.
34. Baxter, S.D., Smith, A.F., Litaker, M.S., Guinn, C.H., Shaffer, N.M., Baglio, M.L., and Frye, F.H., *Recency affects reporting accuracy of children's dietary recalls*. Ann Epidemiol, 2004. **14**(6): p. 385-90.
35. Baxter, S.D., Thompson, W.O., Davis, H.C., and Johnson, M.H., *Impact of gender, ethnicity, meal component, and time interval between eating and reporting on accuracy of fourth-graders' self-reports of school lunch.* J Am Diet Assoc, 1997. **97**(11): p. 1293-8.
36. Baxter, S.D., Thompson, W.O., Litaker, M.S., Frye, F.H., and Guinn, C.H., *Low accuracy and low consistency of fourth-graders' school breakfast and school lunch recalls.* J Am Diet Assoc, 2002. **102**(3): p. 386-95.
37. Baxter, S.D., Thompson, W.O., Smith, A.F., Litaker, M.S., Yin, Z., Frye, F.H., Guinn, C.H., Baglio, M.L., and Shaffer, N.M., *Reverse versus forward order reporting and the accuracy of fourth-graders' recalls of school breakfast and school lunch*. Prev Med, 2003. **36**(5): p. 601-14.
38. Smith, A.F., Domel Baxter, S., Hardin, J.W., and Nichols, M.D., *Conventional analyses of data from dietary validation studies may misestimate reporting accuracy: illustration from a study of the effect of interview modality on children's reporting accuracy*. Public Health Nutr, 2007. **10**(11): p. 1247-56.
39. USDA Food and Nutrition Service. *Eligibility Manual for School Meals.* 2008; Available from: http://www.fns.usda.gov.
40. Sprinthall, R.C., *Basic Statistical Analysis*. 8th ed. 2007, Boston: Allyn and Bacon.
41. Baglio, M.L., Baxter, S.D., Guinn, C.H., Thompson, W.O., Shaffer, N.M., and Frye, F.H., *Assessment of interobserver reliability in nutrition studies that use direct observation of school meals.* J Am Diet Assoc, 2004. **104**(9): p. 1385-92.

APPENDICES

Appendix A: Memorandum of Understanding

MEMORANDUM OF AGREEMENT
Between

PARTY A: (School name and address withheld)

PARTY B: Board of Regents, Nevada System of Higher Education, on behalf of University of Nevada Cooperative Extension, 5305 Mill Street, Reno, NV 89502

I. PURPOSE AND SCOPE

The purpose of this Agreement is to identify the roles and responsibilities of each party as they relate to the Nutrition in the Garden: Grow Yourself Healthy pilot project at (school name withheld).

II. BACKGROUND

(School name withheld) is a charter elementary school operating in Reno, Nevada. Total enrollment is 197 students. Seventy-five percent of the students are eligible to receive free or reduced price school meals, a proxy indicator of low economic status. Eighty-eight percent are Hispanic, and of whom English is a second language for 91 percent according to the school's principal. (School name withheld) is located in Washoe County, Census Tract 22.03, where 28% of families with children have incomes below the poverty level. Forty percent of adults 25 years old and older have less than a high school education. Characteristics such as low income, low educational attainment, and racial/ethnic minority status are linked to increased health risk and adverse health outcomes. Obesity and attendant risk of diabetes Type 2 are of particular concern within the Hispanic population as their incidence rate exceeds that of other ethnic groups (National Institutes of Health, 2006). This pilot project will be conducted with the 44 fourth and fifth grade students attending (school name withheld).

University of Nevada Cooperative Extension (UNCE) consists of four geographic areas, equivalent to university departments. The Western Area, which encompasses Washoe, Douglas, and Storey Counties and Carson City, has over 50 staff and faculty. The University of Nevada Cooperative Extension is one of the ten colleges of the University of Nevada, Reno (UNR). As part of the land grant system, it is also a part of the Cooperative Extension System, a nationwide education network linking research, science and technology to the needs of the local community. Outreach programs conducted by UNCE-Western Area provide information and skills to assist communities in dealing with identified needs, such as nutrition and health issues. Educational curricula and community-based programs are developed to address these critical issues using innovative delivery methods.

The Nutrition in the Garden: Grow Yourself Healthy (NITG) pilot project will develop and deliver an integrated science-based curriculum specific to fourth and fifth grade levels. The curriculum will be integrated and linked to the county education standards for science, language arts, math and social sciences. In addition to the classroom instruction, the project will also create a school garden which will support knowledge and skills presented in the classroom, while increasing students' physical activity levels.

111. (SCHOOL NAME WITHHELD) RESPONSIBILITIES UNDER THIS AGREEMENT.

(School name withheld) agrees to do the following:

- Allow UNCE project team to meet with (school name withheld) staff to inform them about the NITG project and obtain their input and guidance.
- Allow UNCE to provide teachers and staff with project information via email and other forms of communication.
- Allow UNCE to meet with teachers/staff to facilitate incorporation of the NITG curriculum and learning activities into lesson plans.
- Allow UNCE to work with teachers/staff in obtaining student input into the garden design.
- Allow UNCE to work with teachers/staff in providing classroom instruction on project topics.
- Allow UNCE to conduct special food tasting events during mutually agreed upon times.
- Provide waste receptacles during the food tasting events.
- Provide supervision of the students during the food tasting events.
- Allow UNCE to assist with the coordination and implementation of garden construction.
- Provide supervision of the students during garden activities.
- Allow and assist UNCE to obtain parental permission for fourth and fifth grade students willing to participate in the evaluation component of the project.
- Allow UNCE to conduct the voluntary evaluation components of the project with the fourth and fifth grade students, including:
    - collection of demographic data, heights, weights and percent body fat (using a special bio-impedance scale),
    - written pre- and post-knowledge and food behavior evaluation,
    - pre- and post-assessment of physical activity (using pedometers).
- Allow UNCE to conduct a post-evaluation survey of teachers and staff in order to evaluate and improve the NITG project.

IV. UNIVERSITY OF NEVADA COOPERATIVE EXTENSION'S NUTRITION IN THE GARDEN PROJECT RESPONSIBILITIES UNDER THIS AGREEMENT.

UNCE-NITG project shall undertake the following activities:

- Present information about the NITG project at school-based meetings to faculty, staff and parents.
- Maintain communication about project planning and progress with (school name withheld) principal, teachers and staff.
- Provide NITG project assistance to (school name withheld) teachers and staff.
- Provide NITG project classroom instruction with the consent of (school name withheld) and teachers.
- Coordinate and conduct food tasting events.
- Coordinate with (school name withheld) teachers and staff on garden construction and maintenance.
- Conduct the voluntary pre- and post-project evaluation components.
- Coordinate and manage the Trust Fund for Public Health NITG grant, e.g. purchasing curriculum materials and garden supplies and completing all required reports.

V. IT IS MUTUALLY UNDERSTOOD AND AGREED BY AND BETWEEN THE PARTIES THAT:

This Memorandum of Understanding can be revoked by either party without cause with a 30-day written notice of revocation

VI. FUNDING

This agreement does not include any exchange of funds between the two parties. UNCE will supply the nutrition education and garden materials and supplies defined in the Trust Fund for Public Health grant which supports the NITG project.

VII. EFFECTIVE DATE AND SIGNATURE

This Memorandum of Understanding shall be effective upon the signatures of Parties A and B authorized officials. It shall be in force from October 1, 2006 to September 30, 2007.
Parties A and B indicate agreement with this Memorandum by their signatures.
Signatures and Dates

_____ _____
(School name and address withheld) Date

_____ _____

The Nevada System of Higher Education Date
On behalf of the University of Nevada Cooperative Extension

Appendix B: Permission to Participate (English)

UNIVERSITY OF NEVADA, RENO
PERMISSION TO PARTICIPATE IN A RESEARCH STUDY

TITLE OF STUDY: Nutrition in the Garden: Grow Yourself Healthy

INVESTIGATORS: Kerry Seymour, MS, RD, CDE; Kerrie Badertscher, CPH; Karen Spears, PhD, RD; Jackie Reilly, MS; Michael Havercamp, PhD

PROTOCOL NUMBER: B06/07-004

Dear Parent or Guardian,

In 2007, all 4th and 5th grade students of (school name withheld) will learn about food, plants, and gardening. Your child will taste fruit and vegetables, and help with a school garden.

Purpose
We are conducting a research study named **Nutrition in the Garden: Grow Yourself Healthy**. Participation in the study is voluntary. We want to know if children who learn about food, plants, and gardening change their food choices or activity levels.

You must give written permission if you **do not** want your child to join this study.

As part of this study, your child will be asked to fill out a paper survey. Your child will write down his or her age, gender and ethnic group. The survey questions also ask about food, plants, and computer use. When the survey is done, your child's physical activity level, height, weight, and body fat will be measured.

This letter gives you the chance to refuse to have your child join the study. Even if you agree, your child can refuse to continue with the study at any time. Your child's grades will not be affected in any way.

Risks

The risks to your child in this study are small. Your child may feel discomfort when answering the questions on the survey. Your child may feel discomfort when being measured. There is a possible risk of injury to your child while taking part in activities in the school garden.

IMPORTANT - A very small electric signal is sent through the body to measure body fat. A child with a heart problem **should not** have their body fat measured. They may join the study, but should not have their body fat measured. There is a place at the end of this form to tell us if your child has a heart problem.

Benefits

We do not promise any benefit to you or your child for being part of this study. This study *may* increase what your child knows about plant foods, and *may* help your child eat more vegetables and fruits. This study *may* also increase your child's computer skills and physical activity.

Confidentiality

Your child's identity will be protected as much as allowed by law. Your child's name will not be on the paper survey. A code number will be used instead. Your child's information will be stored in a secure location at our office and will be kept until the study is done.

We will not identify you or your child in any reports. Only the study investigators, project staff, and the University of Nevada, Reno Social Behavioral Institutional Review Board will see the information we collect. Videos or photos of students may be taken to show how this program was done. You will be asked for permission before your child is videotaped or photographed.

Costs/payment

There is no cost to you if your child joins this study. There is no payment to you or your child if your child joins this study. If your child is injured as a result of taking part in this research study, you are responsible for the medical costs. The University of Nevada will not pay for or give free medical care.

Right to refuse or withdraw

You may refuse to have your child join the study. Your child may stop being part of the study at any time without penalty. You will be told if the study (or use of the study information) is changed. You will also be told of any important findings that happen during this study which may affect your choice to have your child continue.

Questions

If you have questions at any time about this project, please ask us. You may contact any one of the following persons:

Kerry Seymour	784-4848
Kerrie Badertscher	784-4848
Karen Spears	784-1775
Jackie Reilly	784-4848
Michael Havercamp	784-4848

You or your child may report your concerns about how this study is being done to the **University of Nevada, Reno Social Behavioral Institutional Review Board.** You do not have to give your name.

By phone:
(775) 327-2368

By mail:
University of Nevada, Reno Social Behavioral Institutional Review Board
C/o Office of Human Research Protection
205 Ross Hall/331
University of Nevada, Reno
Reno, NV 89557-0246

If you **do not** want your child to be in this research study please complete the next page and return it to your child's teacher by January 15, 2007. If you do not return the next page we will include your child in the research study as explained above.

My signature below indicates that I **do not** want my to participate in the research study:
Nutrition in the Garden: Grow Yourself Healthy

_____

_____
Child's name (please print)

_____
Signature of parent /legal guardian Date

Return this form to your child's teacher by January 15, 2007

My signature below indicates that my child has a **known heart problem** and should not have their body fat measured. My child can participate in the rest of the study:
Nutrition in the Garden: Grow Yourself Healthy

_____

_____
Child's name (please print)

_____
Signature of parent /legal guardian Date

Do you know about the USDA Food Stamp Program that provides nutrition assistance to people with low income?

For more information, call 1-800-992-0900 (ext. 0500) or go online to http://www.welfare.state.nv.us.

Appendix C: Permission to Participate (Spanish)

Estimados Padres:

En el año 2007 todos los estudiantes de los grados 4^{o} y 5^{o} de (school name withheld) estudiarán temas sobre los alimentos, las plantas y la jardinería. Su hijo/a probará diferentes frutas y vegetales y ayudará en el jardín de la escuela.

Objetivo
Estamos llevando a cabo un studio de investigación llamado **Nutrición en el Jardín; Crece Sano.** La participación en el estudio es voluntaria. Con este estudio queremos saber si los niños que estudian las plantas y los alimentos y aprenden jardinería cambian su elección de alimentos y sus niveles de actividad.

Si usted no desea que su hijo/a participe en el estudio, deberá completar el documento de la pagina 4.

Como parte de este estudio, su hijo/a tendrá que completar un cuestionario. Su niño escribirá su edad, sexo y grupo étnico. En el cuestionario también habrá preguntas acerca de alimentos, plantas y uso de computadoras. Cuando el cuestionario haya sido completado, se medirá el nivel de actividad física, la altura, el peso y el índice de grasa corporal.

Esta carta le da la oportunidad de rechazar la oferta de participar en el estudio. Incluso si usted ha decidido que su hijo/a participe pero por cualquier motivo no quiere continuar, puede dejarlo en cualquier momento. La evaluación escolar de su hijo/a es totalmente independiente y no se vera afectada de ningún modo.

Riesgos
El riesgo que pueda tener su hijo/a será mínimo. Su hijo/a puede sentirse incómodo cuando tenga que responder a las preguntas del cuestionario. Puede que se sienta incómodo también cuando lo midan y pesen. También existe la posibilidad de que sufra pequeños daños mientras participa en las actividades del jardín escolar.

IMPORTANTE – Una pequeña cantidad de señales eléctricas es emitida para medir el índice de grasa corporal. A los niños con problemas cardíacos **no se les debe** medir el índice de grasa. Pueden participar en el estudio, pero no se les hará la medición de grasa. Hay un espacio al final de esta hoja donde nos puede decir si su hijo/a tiene problemas cardíacos.

Beneficios

No le prometemos ningún beneficio a usted o a su hijo/a por el hecho de participar en el estudio. Este estudio puede que aumente el conocimiento de su niño sobre las plantas y los alimentos y puede que le ayude a consumir mas vegetales y frutas. Este estudio también puede llevar a un aumento en la actividad física de su niño y en su habilidad con el computador.

Confidencialidad

La identidad de su hijo será protegida tanto como lo permita la ley. El nombre de su niño no aparecerá en los documentos del estudio. En su lugar utilizaremos un código para identificarle. Toda la información referente a su hijo/a permanecerá en un lugar seguro en nuestra oficina hasta que el estudio finalice.

No identificaremos a su hijo, o a usted, en ninguno de nuestros trabajos o publicaciones. Sólo los investigadores, personal del proyecto y la Universidad de Nevada, Reno Biomedical Institutional Review Board verán la información que recopilemos. Se tomarán videos y fotografías para documentar cómo se realizó el programa. Les pediremos su autorización antes de gravar en video o fotografiar a su hijo/a.

Coste/pagos

Participar en este estudio no conlleva ningún costo para usted. Tampoco se le pagará a usted o a su hijo/a por participar en el estudio. Si su hijo/a sufre una lesión durante su participación en el programa, usted es responsable de los gastos médicos. La Universidad de Nevada no pagará o dará servicios médicos.

Derecho a rechazar o interrumpir la participación

Usted puede rechazar que su hijo/a participe en el estudio. Su hijo/a puede interrumpir su participación en el estudio en cualquier momento sin ninguna consecuencia. Se le informará si el estudio (o el uso de la información del

estudio) se cambia. También se le informará de cualquier descubrimiento importante que ocurra durante este estudio que pueda afectar su decisión de dejar que su hijo/a continúe participando en el programa.

Preguntas

Si tiene alguna pregunta, puede ponerse en contacto con nosotros en cualquier momento llamando a cualquiera de estos teléfonos:

Kerry Seymour	784-4848
Kerrie Badertscher	784-4848
Karen Spears	784-1775
Jackie Reilly	784-4848
Michael Havercamp	784-4848

Usted o su niño pueden hacer quejas o sugerencias sobre como se esta llevando a cabo este estudio llamando a University of Nevada, Reno Biomedical Institutional Review Board. No tiene que dar su nombre si no lo desea.

(775) 327-2368

O por escrito a la dirección:
University of Nevada, Reno Biomedical Institutional Review Board
C/o Office of Human Research Protection
205 Ross Hall/331
University of Nevada, Reno
Reno, NV 89557-0246

Si usted **no desea** que su hijo/a participe en este estudio de investigación, por favor, complete la página siguiente y entréguesela a la maestra de su niño no más tarde del 10 de enero del 2007. Si no entrega esta página firmada, entenderemos que quiere que su hijo/a sea incluido en el estudio.

Con mi firma, indico que no deseo que mi hijo/a participe en el estudio de investigación **Nutrición en el jardín: Crece Sano**.

_____

_____
Nombre del niño/a (letra de imprenta)

Firma de los Padres /Representante legal Fecha

Entregue esta página a la profesora de su hijo/a no más tarde del 10 de enero del 2007.

Con mi firma, indico que mi hijo/a **tiene problemas cardíacos** y no deberá ser incluido en la medición del índice de grasa corporal. Mi hijo/a podrá participar en el resto del estudio de **Nutrición en el Jardín: Crece Sano**.

Nombre del niño/a (letra de imprenta)

Firma de los padres Fecha

Do you know about the USDA Food Stamp Program that provides nutrition assistance to people with low income?
For more information, call 1-800-992-0900 (ext. 0500) or go online to http://www.welfare.state.nv.us.

Appendix D: Food Record/Diary Booklet (English)

How to keep a food diary

What is a food diary?
A food diary is a record of everything you ate and drank in a day.

How do I fill out a food diary?
Write down every food or drink you had on the pages attached.
Check the box to show where you had the food or drink.
Write down how much you ate or drank. Describe how big the serving was.

Can others help me?
Yes, you can ask someone to help you fill out the diary. You can have them look over your list of foods and drinks to see if you wrote down everything.

When do I need to turn the diary in?
Take the diary home each night to write down what you ate or drank away from school. Bring the diary back to school each morning.

How many days do I need to keep a food diary?
You will keep a food diary for 3 full days.

Sample food diary

Day 1 code number: 007 **date:** 10/5/07

Meal	**What you ate or drank**	**Amount**	**Where you ate or drank**
Breakfast	Cheerios Milk –whole Apple juice	1 small bowl of cereal (1/2 cup) Large glass (8 ounces) Small glass (4 ounces)	☐ home ☐ school ☐ other
Lunch	Peanut butter and jelly sandwich Chocolate chip cookie Milk, 2%	½ 2 medium 1 carton	☐ home ☐ school ☐ other
Snack	Apple	1- almost all	☐ home ☐ school ☐ other

Day 1 **code number:** **date:**

Meal	**What you ate or drank**	**Amount**	**Where you ate or drink**
Breakfast			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other
Lunch			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other
Dinner			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other

Day 1

Extra questions: put a check in the box showing what you did on Day 1

Did you drink any fruit juice?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat any fruit?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat a green salad?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat cold vegetables? (like carrots, celery)	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat cooked vegetables? (count potatoes, but don't count french fries or potato chips)	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more

Day 2 **code number:** **date:**

Meal	**What you ate or drank**	**Amount**	**Where you ate or drank**
Breakfast			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other
Lunch			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other
Dinner			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other

Day 2

Extra questions: put a check in the box showing what you did on Day 2

Did you drink any fruit juice?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat any fruit?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat a green salad?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat cold vegetables? (like carrots, celery)	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat cooked vegetables? (count potatoes, but don't count french fries or potato chips)	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more

Day 3 **code number:** **date:**

Meal	**What you ate or drank**	**Amount**	**Where you ate or drank**
Breakfast			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other
Lunch			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other
Dinner			☐ home ☐ school ☐ other
Snack			☐ home ☐ school ☐ other

Day 3

Extra questions: put a check in the box showing what you did on Day 3

Did you drink any fruit juice?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat any fruit?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat a green salad?	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat cold vegetables? (like carrots, celery)	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more
Did you eat cooked vegetables? (count potatoes, but don't count french fries or potato chips)	☐ yes ☐ no					
How many times?	0	1	2	3	4	5 or more

Appendix E: Food Record/Diary Booklet (Spanish)

Cómo organizar un diario de nutrición

¿Qué es un diario de nutrición?
Un diario de nutrición es una lista en la que anotamos los alimentos y bebidas que consumimos cada día

¿Cómo rellenamos el diario nutritivo?
Escriba los alimentos y/o bebidas que consuma en la gráfica adjunta.
Marque con una **X** la casilla que indica donde consumió esos alimentos y/o bebidas.
Anote las porciones y/o el tamaño de los alimentos y bebidas que consumió

¿Puedo recibir ayuda?
Si, puedes pedirle a alguien que te ayude a rellenar tu diario. Puedes pedirles que comprueben si anotaste todos los alimentos y bebidas que consumiste en el día y si las cantidades son correctas.

¿Cuándo tengo que entregar mi diario de nutrición?
Cada día llevarás tu diario a casa para anotar los alimentos consumidos fuera de la escuela. Trae tu diario de vuelta a la escuela cada día.

¿Cuántos días tengo que rellenar mi diario de nutrición?
Anotarás en tu diario de nutrición durante 3 días.

Ejemplo del diario de nutrición

Día 1 **Código número: 007** **Fecha:** 10 enero de 2007

Comidas	**¿Qué has comido o bebido?**	**Cantidad**	**¿Dónde?**
Desayuno	Cereal – ("Cheerios", otro) Leche – (entera, 2%, 1%, desnatada) Jugo (manzana, naranja, otro)	1 tazón pequeño (1/2 cup) 1 vaso grande (8 ozs.) 1 vaso pequeño (4 ozs.)	☐ casa ☐ escuela ☐ otro
Almuerzo	Sandwich de mantequilla de cacahuate y mermelada Galleta de chocolate Leche, 2%	Medio 2 medianas 1 cartón	☐ casa ☐ escuela ☐ otro
Merienda (botana, snack)	Manzana	1- casi toda	☐ casa ☐ escuela ☐ otro

Día 1 **Código número:** **Fecha:**

Comida	**¿Qué has comido o bebido?**	**Cantidad**	**¿Dónde?**
Desayuno			☐ casa ☐ escuela ☐ otro
Botana, snack…			☐ casa ☐ escuela ☐ otro
Almuerzo			☐ casa ☐ escuela ☐ otro
Merienda, botana, snack			☐ casa ☐ escuela ☐ otro
Cena			☐ casa ☐ escuela ☐ otro
Snack			☐ casa ☐ escuela ☐ otro

Día 1
Pregunta extra: marca con una **X** lo que hiciste en el día 1

¿Bebiste jugo de fruta?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste alguna fruta?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
Comiste ensalada vegetal?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste vegetales crudos? (zanahorias, apio, tomates…)	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste vegetales cocinados? (puedes anotar las papas, siempre que no sean fritas)	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más

Día 2 **Código número:** **Fecha:**

Comida	**¿Qué has comido o bebido?**	**Cantidad**	**¿Dónde?**
Desayuno			☐ casa ☐ escuela ☐ otro
Botana, snack…			☐ casa ☐ escuela ☐ otro
Almuerzo			☐ casa ☐ escuela ☐ otro
Merienda, botana, snack			☐ casa ☐ escuela ☐ otro
Cena			☐ casa ☐ escuela ☐ otro
Snack			☐ casa ☐ escuela ☐ otro

Día 2
Pregunta extra: marca con una **X** lo que hiciste en el día 1

¿Bebiste jugo de fruta?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste alguna fruta?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
Comiste ensalada vegetal?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste vegetales crudos? (zanahorias, apio, tomates…)	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste vegetales cocinados? (puedes anotar las papas, siempre que no sean fritas)	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más

Día 3 **Código número:** **Fecha:**

Comida	**¿Qué has comido o bebido?**	**Cantidad**	**¿Dónde?**
Desayuno			☐ casa ☐ escuela ☐ otro
Botana, snack…			☐ casa ☐ escuela ☐ otro
Almuerzo			☐ casa ☐ escuela ☐ otro
Merienda, botana, snack			☐ casa ☐ escuela ☐ otro
Cena			☐ casa ☐ escuela ☐ otro
Snack			☐ casa ☐ escuela ☐ otro

Día 3
Pregunta extra: marca con una **X** lo que hiciste en el día 1

¿Bebiste jugo de fruta?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste alguna fruta?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
Comiste ensalada vegetal?	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste vegetales crudos? (zanahorias, apio, tomates…)	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más
¿Comiste vegetales cocinados? (puedes anotar las papas, siempre que no sean fritas)	☐ si ☐ no					
¿Cuántas veces?	0	1	2	3	4	5 ó más