GRAIN-BASED FOODS 24-HOUR PORTION SIZE RECALL COMPARED TO PORTION PHOTO SELECTION BY UNIVERSITY STUDENTS

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ABSTRACT

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Grain-Based Foods 24-Hour Portion Size Recall Compared to

Photo Portion Selection by University Students.

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The ubiquity of fast food outlets, the huge increase in restaurant portion sizes at restaurants, and the shift to an auto-oriented, TV-watching lifestyle has resulted in an obesity epidemic caused by societal changes in the 20th century (Nestle and Jacobsen, 2000). From a practitioner's viewpoint, finding methods that will effectively assist in determining actual food portions will be pivotal to advocating change. Nationwide food consumption surveys employ the 24-hour food recall because of its cost-efficiency, ease of administration and low respondent burden. Food photograph accompaniment may help subjects estimate portion size. Nelson *et al*. (1994, 649) reported that a process

composed of perception, conceptualization, and memory takes place when a photograph is used to identify portion size during an interview and Chambers *et al*. (2000, 891), described cognitive strategies used by interview respondents when making judgments about portion size. Nelson *et al*. from the UK (1994, 1996, 1998a, 1998b), extensively examined food photography use in portion size assessment noting the benefits as well as the inaccuracies. Yet, limited research exists from the US querying the errors associated with estimating food portion sizes from photographs.

This study utilized the *Portion Photos of Popular Foods* (3PF) book (Hess 1997) with the purpose of enhancing the validity of dietary assessment methodology by assessing the impact of a photographic aid on portion size recall. Serving sizes reported from a standard 24-hour dietary recall (24R) were compared to those selected using 3PF (the standard). In view of current food intake trends, the research focus was narrowed to the grain group: breads (including mixed foods), cereals and starchy vegetables.

Forty-two males (mean age 24 y; average BMI 26.04) and 51 females (mean age 22.7 y; average BMI 23) representing 33 distinct non-nutrition majors completed a 24R interview using standard methods with opportunity for demonstration of size using a ruler. Immediately after 24R, subjects selected the 3PF portion closest to their intake. 3PF and 24R differences were expressed in grams, with distinctions made by the researcher between volume rather than density for fair comparison. Over-, under-, and exact reporting were evenly distributed (Chi sq 4.0, p=.13) and not gender related (Chi sq .57, p=.75). 3PF and 24R portions were identical for 52 recalls, but 78 recalls

experienced over 1/3rd portion discrepancy of the 3PF serving, 64% of these being over reported. Out of a possible 37, thirty 3PF grain-based foods were selected by the 93 subjects for a total of 181 comparisons. Eight foods accounted for 61% of the responses (110 total: 106 in female; 75 in male), and included: ready-to-eat cereal, spaghetti, pizza, tortilla chips, bagel, rice, French fries, and pasta salad. Based on recall frequency and reporting direction for these eight foods, spaghetti, pasta salad, tortilla chips, and French fries recalls were inaccurate, accurate for pizza and bagels, and ambiguous for ready-to-eat cereal and rice. Large discrepancies of over 100 grams were noted in both directions (over-, and under-) for spaghetti, and pasta salad. Results advocate for multiple portion-size assessment methods, specifically for amorphous foods. Concomitant photo portion use in 24R may facilitate or deter portion recall, depending on the food. It is clear that photographic portion representations need improvement to allow for food-specific differences.

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List of Abbreviations

3PF	*Portion Photos of Popular Foods* (Hess 1997)
24R	24-hour dietary recall
ADA	American Diabetes Association
BMI	Body Mass Index
Chi sq	Chi square analysis
df	Degrees of Freedom
FDA	Food and Drug Administration
NHANES	National Health and Nutrition Examination Survey
p	p-value; statistics measurement of the significance of test data
SD	Standard Deviation
USDA	United States Department of Agriculture

CHAPTER 1

Introduction

Dietary recalls and, specifically, the amount that people eat, are important when assessing dietary status, shaping food and health policy, determining exposure to environmental risks associated with food, understanding consumption patterns for new food products and forming population-based and high-risk strategies for health promotion and disease prevention (Chambers, Godwin and Vecchio 2000). Various nutrient intake estimation methods exist and have been used extensively in nutritional epidemiological studies. Each method has applications that vary in effectiveness depending on the target group studied. In addition, each method has its own strengths and limitations when it comes to data interpretation. Subjects' responses on either food frequency questionnaires, food diary records or 24-hour dietary recalls depend highly on each individual's ability to accurately estimate portion sizes. Most individuals are not familiar with the standard portion sizes established by the US Department of Agriculture (USDA), the American Diabetes Association (ADA), or Nutrition Facts Label serving sizes. This is further exacerbated by mixed messages launched by the advertising giants. Consumers are targeted into believing that larger portions are both desirable and have become the new standard (Young and Nestle 2002, 247; Food and Brand Lab, 2003).

According to data derived from the Behavioral Risk Factor Surveillance System (BRFSS), a random-digit telephone survey conducted by the Centers for Disease Control and Prevention (CDC) and state health departments, more than half of all U.S. adults are considered overweight defined as having a Body Mass Index (BMI) of 25 or more (Centers for Disease Control and Prevention 2003). The CDC reports that the prevalence

of overweight among U.S. adults has increased by 61 percent from 1991 to 2000 alone (2003). Young and Nestle (2002, 246) looked at the contribution of expanding portion sizes to the US obesity epidemic. They determined that marketplace food portions have indeed increased in size and now exceed federal standards. The authors concluded that because energy content increases with portion size, educational and other public health efforts to address obesity should focus on the need for people to consume smaller portions. Besides larger portioned marketplace foods, the fast-food and restaurant industries have met consumer expectations and demands by producing larger portions, thus enhancing the perception of greater value (Nestle 2003, 40). According to a series of studies conducted by University of Illinois marketing professor Brian Wansink, PhD, consumers tend to eat more of a product at a time if it comes in a larger package (Wansink 1996). He proved this by testing the way people use different-size bottles, boxes, spaghetti, popcorn and m & ms, among other foods. In fact, large portion sizes tend to be underestimated the most in dietary assessments (Nelson, Atkinson and Darbyshire 1996, 36).

Obtaining accurate intake information is integral to assist individuals in making healthier food selections and to establish desirable portion sizes. To achieve this goal, resources to facilitate the process must be utilized to effectively determine actual food consumption. Numerous resources are available to help individuals better describe their actual food portions. Photographs of food have often been used in dietary surveys to help subjects estimate portion size (Nelson, Atkinson, and Darbyshire 1994, 649). A study

conducted by Howat and Church (1995, 8) demonstrated that subjects trained with photos more accurately estimated food portions. Only a handful of resources exist featuring various portion sizes in photographic form. The most comprehensive one to date is the *Portion Photos of Popular Foods* (Hess 1997).

Objectives of this Study

Without any training in portion size estimation most people have a difficult time determining portion sizes. Previous studies demonstrate that visuals improved portion-size estimation. An assumption is that by utilizing visuals, the need to determine concrete volumetric amounts is bypassed. Instead, memory is linked to a cognitive application with the visual acting as the primary catalyst. A premise of this study was that by using photographs of portion sizes, portion-size estimation would improve and/or be enhanced. Specifically, the purpose of this research was to assess the impact a photographic aid has on portion size recall. This study utilized the *Portion Photos of Popular Foods* book (referred to throughout as 3PF) to evaluate its efficacy and the potential to improve food portion reporting accuracy. Objectives of the study were: 1) to differentiate between reporting tendencies (over-, under-, and exact-reporting) comparing 24-hour recall (24R) to 3PF, 2) compare demographic information to those outcomes, and 3) examine the data for any food-specific recall anomalies.

Research Questions

Primary Null Hypothesis: There will be no significant difference between portion sizes reported via a standard 24-hour diet recall (24R) without a photographic aid to those reported with the *Portion Photos of Popular* Foods (3PF) photographic aid.

2nd Null Hypothesis: Differences in gram weight comparisons of 24R portion sizes vs. 3PF portion sizes will not be directional (tendency to over, under or match-report).

3rd Null Hypothesis: Directional differences between recall and 3PF portion sizes will not be associated with gender, BMI and demographics.

Proposed use of findings

The purpose of this study was to measure the impact a photographic aid (3PF) has on portion size estimation and how it compares to standard portion size recollection (24R). The findings could contribute to improving current dietary assessment practices regardless of whether photographic aids prove to be of benefit or are inconsequential to the outcomes.

Assumptions of this Study

An assumption was that students were honest in their responses in the interviews, and described to the best of their ability the actual portion sizes consumed of the foods

reported for the 24-hour dietary recall. Another assumption is that students understood English, had good vision, and were not color blind.

Delimitations of this Study

The scope of this study was limited to non-nutrition major students at the University of Wisconsin-Stout. Students participating in the pilot study were taking a general elective nutrition course in the Spring semester, 1998. The students recruited for the main study were enrolled in business classes in the Spring semester, 1998, and Summer session, 1998. Non-nutrition majors were specifically selected to minimize previous training in or familiarity of portion size estimation.

Limitations of this Study

According to Campbell and Stanley (1963, 9), the effect of testing is an extraneous variable that can jeopardize internal validity in a pre-test, post-test design. Specifically, "the effects of taking a test upon the scores of a second testing". The effect of testing relates to responses that are deemed acceptable (Campbell and Stanley 1963, 9). Students may respond to questions according to expectations rather than their own beliefs. For this study, it was evident that a couple students had inquired about the premise of the "diet interview" with classmates and arrived with a food diary. This may have influenced portion reporting and estimation.

Another extraneous variable affecting internal validity is instrumentation, in which changes in the calibration of a measuring instrument or changes in the observers or scorers used may produce changes in the obtained measurements (Campbell and Stanley

1963, 5). Instrumentation or "instrument decay" is in reference to autonomous changes in the measuring instrument. In this case, the interviewer process (e.g. fatigue) over time might account for differences. Similarly, when interviewing students, the interviewer's familiarity with the interview schedule and with particular students may produce shifts (Campbell and Stanley 1963, 9).

Per Campbell and Stanley (1963, 9), "it has long been a truism in the social sciences that the process of measuring may change that which is being measured. The test-retest gain would be one important aspect of such change". This change is referred to as the reactive or interaction effect of testing and is a factor that jeopardizes external validity or representativeness. The reactive effect is where a pretest might increase or decrease the respondent's sensitivity or responsiveness to the experimental variable and thus make the results obtained for a pretested population unrepresentative of the effects of the experimental variable for the unpretested universe from which the experimental respondents were selected (Campbell and Stanley 1963, 6). So in essence, the process of measuring food intake in and of itself would affect findings. The pre-test in this study (a 24-hour dietary recall) relies on memory, and if uncertain, the subject may create a new estimation.

Other viable limitations include not pre-assessing participants' prior familiarity with portion size estimation and thus not establishing a base knowledge in food measurement. The student population selected were non-dietetics and non-hotel/restaurant management students, and thus would not have been required to take

classes which teach food portion and estimation skills. Participants were not trained to better enable them to estimate portion sizes of various quantities (volume, amorphous, or solid), so it assumed that the responses solicited are representative of the general public not having any training in portion-size estimation. Also, students participating in this study did so for extra credits and may differ in some way from students who chose not to earn extra credit, so the recruitment process was limited to motivated people.

Other considerations warranting potential inclusion on the demographic questionnaire include discerning if a participant has color blindness. This could impact responses when dealing with color photographs. In addition, no information was solicited regarding weight gain or weight loss in the previous year. It is well established that weight fluctuations and weight pre-occupation can bias responses. Age, sex, BMI and portion size are all potentially important confounders when estimating food consumption or nutrient intake using photographs (Nelson and Darbyshire 1996, 31). Other characteristics reported by Nelson and Haraldsdóttir (1998, 221) that may influence food recall perception include short term (e.g. whether or not a subjects is hungry), or long term (e.g. level of food restraint, independent of factors such as body mass index (BMI) or weight).

Design of the research

The research involved a cohort study using the one-group pre-test-post-test design (Campbell and Stanley 1963). Gibson (1990, 110) noted that caution must be used when

correlation analysis is used to evaluate the extent of the agreement in a test-retest design for measuring precision. The correlation coefficients cannot be judged on a null hypothesis basis of no correlation because there is an *a priori* reason to believe that the methods are positively correlated.

Organization of the Research

This thesis is organized in five sections. A review of literature is presented in chapter two. Research methodology is presented in chapter three. Chapter four presents the results of this research including demographic data of the subjects, the trends in over-, under-, and exact food portion reporting, and how this relates to age, gender, and BMI. Discussion, conclusions, and recommendations follow in chapter 5. References and Appendices conclude the research paper.

CHAPTER 2

Review of Literature

Introduction to Dietary Assessment

Faggiano et al. (1992, 379) report that the "Investigation of dietary habits is one of the most challenging activities in epidemiology. Misclassification of exposure is likely to occur, and its extent may be considerable, particularly in retrospective surveys." Faggiano et al. further state that other authors have argued that the collection of information on portion size is not critical given the dominance of frequency of consumption in the estimation of average intake. However, it is noted, "This conclusion could be influenced by inaccuracies in size estimation." The assessment of dietary intake involves the collection of information on foods and beverages consumed. According to Smiciklas-Wright and Guthrie (1995, 165):

> The consumption data can be used to compute intake of energy, nutrients, and other food components as well as the consumption patterns for specified food groups. The basic methods for assessing dietary intake have been used for a long time, but there has been a significant expansion in the attention paid to dietary intake methodology with the national focus on nutrition monitoring and with the epidemiological and clinical interests in the relationships between diet, health, and disease.

Purpose of dietary assessment

Thompson and Byers (1994, 2245S) note that many comprehensive and technical reviews have been published on dietary assessment methods. According to Smiciklas-

Wright and Guthrie (1995, 165), dietary data are collected for different purposes ranging from "estimation of population prevalence of particular foods or food components, to study time trends in consumption patterns, to compare intakes of groups, and to study the relationships between intake and health outcomes."

Why is this important?

Various dietary collection methods exist. Each method aims to collect data to calculate nutrient and/ or portion-size estimates. Depending on the desired outcome of the data collection, the selected method of choice can range from frequency to quality or quantity of food intake (Smiciklas-Wright and Guthrie 1995, 166). Yuhas et al. (1989, 7473) noted that nutrition researchers and clinicians need accurate reports from individuals concerning the portion amounts consumed. Previous research has established that most people are unable to estimate portion size with enough accuracy to yield useful data. Dietitians use food intake estimates to evaluate the nutritional quality of diets for individuals and groups. However, meaningful conclusions cannot be determined if subjects frequently over- or underestimate their portion sizes.

Comparison of dietary assessment methods in nutritional epidemiology.

Before selecting the most appropriate assessment method, one must consider the reference time period. Retrospective methods focus on past intake, while prospective methods examine information collected after a diet instruction. The following retrospective dietary assessment methods are profiled: food record, food frequency questionnaire, diet history, brief dietary assessment method and 24-hour dietary recall.

Food Records (or Food Diaries)

Food records require the subject to record foods and beverage amounts at the time of consumption. Detailed descriptions include brand names and preparation method. For mixed dishes, the main ingredients in the recipe are listed. Food portion sizes may be estimated by standard household measures, by ruler measurements (e.g. meat or cake), and counts such as eggs or bread slices. The investigator often needs to convert abstract sizes into grams. Errors can occur due to the respondents' inability to quantify portion sizes and because of difficulties associated with converting volume estimates into grams (Gibson 1990, 40). An advantage of food record use is that recording error can be minimized if subjects are given proper directions. Food records do not rely on memory, but require individuals to be highly motivated and literate, which can introduce bias toward including educated persons. Also, food records may need to be kept for a sufficient length to accurately indicate intake (McBean, 2001).

Food Frequency Questionnaire (FFQ)

A FFQ is designed to obtain qualitative, descriptive information about usual food consumption patterns. The questionnaire consists of two components: a list of foods and a set of frequency-of-use response categories (Gibson 1990, 42). The aim of the FFQ is to assess the frequency with which certain food items or food groups are consumed during a specified time period (e.g. daily, weekly, monthly, yearly). Specific combinations of foods included in a focused questionnaire can be used as predictors for intakes (e.g. calcium-intake assessment) (Gibson, 42). Advantages include: may be self-

administered, can be quickly administered, good at describing food intake patterns, and specific information about nutrients can be obtained if food sources of nutrients are confined to a few sources. Disadvantages are: response rates may be lower and incomplete if self-administered, respondent burden rises as the number of foods queried increases, and foods differ in extent to which they are over- and underreported (errors are not random) (Dwyer 1999, 943).

Diet History

The dietary history method, first developed by Burke in 1947, attempts to estimate the subjects' usual food intake over a relatively long period of time (Gibson 1990, 41). The method is used infrequently today because it takes so long, it requires a trained, highly skilled dietitian, and the results are difficult to code and process (Dwyer 1999, 945). It consists of 3 components: 1) 24-hour recall, and collection of information regarding typical eating patterns, 2) 'cross-check' frequency questionnaires to compare to information obtained in #1 and 3) a three-day food record using house-hold measures. This 3rd step is often skipped as it replicates the assessment of recent food intake obtained earlier (Gibson 1990, 41). Precision and validity are apparently higher when the time period under investigation is shorter (i.e. one month)(Gibson 1990, 120). Dwyer (1990 943) lists advantages as: produces a more complete and detailed description of both qualitative and quantitative aspects of overall and usual food intake than do food records, 24-hour recalls, or food frequency questionnaires; eliminates day-to-day variations, provides some data on previous diet before beginning prospective studies, and useful for

longitudinal studies. Beyond the disadvantages already cited, others include: difficult to standardize due to inter and intra-variability among interviewers, depends on subject's memory, time-consuming (takes 1-2 hours to administer), and diet histories overestimate intakes compared with food records collected over the same period because of greater frequencies reported, and costs of analysis are high because records must be checked, coded and entered appropriately (Dwyer 1999, 944).

Brief Dietary Assessment Methods

Short dietary assessment tools are brief methods that provide either qualitative or quantitative information on food groups, a food, or sometimes a specific nutrient (Dwyer 1999, 941). Included are abbreviated food frequency questionnaires (FFQ), food checklists, questionnaires on specific eating or drinking behaviors (e.g., fruit & vegetable or alcohol intake), self-monitoring tools (e.g., fat gram counters to track a specific nutrient; recording the number of food groups eaten). Compared to the other assessment methods, BDAs can be administered in a shorter period of time, are easy to use by non-clinicians, and may be useful for nutrition education. Limitations include lack of quantitative information, and the examination of only a few nutrients or food groups (Dwyer 1999, 941).

24-hour Dietary Recall

In the 24-hour recall method, subjects are asked by the dietitian, trained in interviewing techniques, to recall the subject's exact food intake during the previous 24-hour period or preceding day (Gibson 1990, 37). The respondent is given the

opportunity, without suggestion, to provide detailed descriptions of all foods and beverages consumed, including cooking methods and brand names. Twenty-four-hour recalls can be obtained on single or multiple occasions. Recalls of actual food consumption during the previous 24 to 48 hours are the most reliable, with the maximum period thought to be a month (Dwyer 1999, 942). The 24-hour recall method is easy to administer, economical, and is not dependent on the literacy of the respondent (Edens and Knous 1999). Other advantages include: the time required to administer is short, respondent burden is low so compliance is generally high, data obtained can be repeated with reasonable accuracy, and it is more objective than a diet history. Limitations include the following: Individual diets vary daily, so a single day's intake may not be representative; an experienced interviewer is required; selective forgetting of foods such as liquids, high calorie snacks, alcohol, and fat occurs; reported intake may not be actual but what the interviewer wants to hear; and the tendency to overreport intake at low levels and underreport intake at high levels of consumption, leading to "flat slope syndrome" with reports of group intakes (Dwyer 1999, 943). The skills required to obtain an accurate and unbiased 24-hour recall is a combination of experience, ability to relate to others, and the knowledge required to ask pertinent questions regarding food intake (Edens and Knous 1999). A single 24-hour recall is most appropriate for assessing average intakes of foods and nutrients for a large group, except for persons with poor memories (e.g. some elderly persons), and young children (Gibson 1990, 39). In addition, the multiple pass method has been used to improve 24-hour recalls. With this

technique, an interviewer asks a respondent several times (ie, passes through the day) to search his or her memory to increase retrieval of the requested information (Jonnalagadda et al. 2000, 304).

Cognitive Research related to Dietary Assessment

Merriam-Webster's dictionary (2003) defines cognition as "the act or process of knowing including both awareness and judgment; *also* **:** a product of this act" (e.g. acquiring an idea). It is important to determine what cognitive processes people use for remembering how much they ate. A greater understanding would help identify portion-size aids that more closely represent what was consumed. This broadens the considerations needed when selecting an appropriate assessment method. Chambers, Godwin and Vecchio closely examined and classified cognitive strategies, definitions, and examples used to describe portion sizes during the recall procedure (2000, 893). It was found that the most frequently used strategy was visualization. Study participants were best able to use aids that could be visualized as similar to the actual portions of containers of foods eaten suggesting that similarly sized or shaped objects can serve as cues for memory recall than objects that might hold the same amount, but look different. This finding parallels another study by Nelson and Haraldsdóttir (1998, 219) who examined theoretical concepts related to portion size estimation. In considering the design of a food photograph series, the researchers noted three psychological constructs, which allow subjects to relate a photographic depiction of a given amount of food to an amount of food actually consumed. These are: 1) *Perception of foods* in photographs in

direct comparison with foods being shown to the subject; 2) *Conceptualization of foods*, i.e. the ability to translate an abstract mental impression of an amount seen or eaten into an amount depicted in a photograph; and 3) *Memory of amounts eaten*, especially relevant to recall of diet using 24-h recall, diet history (DH) or food frequency questionnaires (FFQ).

Baxter et al. (1997, 31) described a cognitive model proposed by Baranowski and Domel (1994) of children's reporting of food intake. The model, which consists of a sensory register, short-term memory, and long-term memory as its three structural components, ascribes various errors in children's self-reports of diet to such processes as attention, perception, organization, retention, retrieval, and response formulation. Baxter et al. (1997, 36) assert that given the wide variety of retrieval categories used by fourth graders, "We cannot assume to know which retrieval categories one student will use on the basis of the retrieval categories used by another student. Descriptive results indicated that the profile of retrieval categories used for matches by accurate students differed from that of inaccurate students." This observation illustrates the differences that exist between each person's abilities to formulate observed or consumed portion amounts. Diet assessment strategies employed may need to be tailored to each person's skills, experiences, and pre-dominant cognitive level.

Influences of sex, age and body size on assessment

Respondents to dietary surveys tend to underreport foods they think are bad and over-report foods they think are good (Nestle 2003, 39). A person's gender, age and

body size can also influence portion size estimations. Nelson, Atkinson and Darbyshire (1996, 45) looked at the use of food photographs for estimating portion size and the nutrient content of meals. Subjects aged between 18 and 90, from a variety of backgrounds, consumed one meal where each portion was self-served, weighed, and then consumed. Within 5 minutes of completion of the meal, subjects were given a visual analogue scale (VAS) and a set of eight color photographs for each food they had eaten. The results of the study suggested that in both men and women there was a marked tendency to overestimate small portion sizes (especially in men) and to underestimate large portion sizes to a greater extent when relying on conceptualization skills (and having consumed the food) than when using perceptual skills alone. Nelson et al. (1996, 32) found that subjects over 65 years tended to overestimate portion size more than younger subjects, and those with a BMI $\geq$ 30 kg/m² tended to underestimate portion size in comparison with those with BMI < 30 kg/m².

Portion size estimation resources

Posner et al. (1992, 738) reported on the need for developing reliable and reproducible methods for assessment of dietary intake, particularly for large-scale studies. Because of the cost-efficiency, 24-hour recalls are commonly used. Requiring respondents to describe food portions can be a potential obstacle; so 3-dimensional, 2-dimensional and pictorial models for describing sizes are generally utilized. Foods in which edible portions are difficult to estimate (such as chicken parts) or foods purchased in commercial portions, have identifiable standards based on those used by the National

Health and Nutrition Examination Survey (NHANES) and the USDA during the Nationwide Food Consumption Survey (NFCS) (Posner 1981, 10).

Three-Dimensional (3D) food portion-size resources

The NFCS use common household measures, such as cups and measuring spoons. Other household measures include glasses, plates and bowls. These are frequently used as a reference for quantifying portion sizes. NHANES used an extensive set of three-dimensional models. Models can be easily recognizable shapes to illustrate portion size: e.g., tennis ball (1 C cooked rice), golf ball (2 Tbs peanut butter), deck of cards (3 ounces of meat), or items such as cans or food containers. Portion-size training using food models demonstrated significant training effects with improvements noted specifically for amorphous foods and solid foods estimated in cups (Weber 1997, 177). The cost for most basic 3-D measures is nominal. On the other hand, realistic replications of actual foods (e.g. Nasco brand food models) can be costly. The Nasco models are made of colorful, pliable plastic and are based on the standard portion sizes set by the USDA (Nasco, 2003). The close resemblance to the real food makes these appealing to most subjects and as noted by Chambers, Godwin and Vecchio (2000, 893), similar shapes and designs can aid in memory recall. A basic package of 36 Nasco food replicas starts at $160, with the option to combine several packages (91 items total) for $422.

Real food samples can also be used for comparison purposes. A number of studies (McQuire et al. 2001, 470; Robinson 1997, 117) required subjects to observe a

pre-weighed food sample, and subsequently were asked to estimate the portion size. Discrepancies between the irregular appearance of the actual food (e.g., muffins) vs. the symmetrical and linear depiction of the 2D food model resulted in significant overestimation (McQuire et al. 2001, 471). The authors note that this discrepancy supports the need to validate new aids before their use.

Two-Dimensional (2D) food portion-size resources

The difference between 3D and 2D is the perspective required to conceptualize a portion-size. The concrete presence of a model shifts to a paper representative. Two-dimensional aids have been used in many studies as a portion-size aid. Unannounced 24-hour dietary recalls conducted by telephone interview have used 2D resources successfully (Buzzard et al. 1996, 574). Drawings of real foods, abstract shapes, household measures are commonly depicted on 2D portion-size estimation aids.

Posner et al. (1992, 738) tested the validity of a two-dimensional food model chart within the context of 24-hour dietary recalls. Relative validity was assessed by comparing food energy and nutrient intakes calculated from food quantity estimates derived from the two-dimensional chart with those derived from three-dimensional food models used in the first National Health and Nutrition Examination Survey (NHANES I). The two portion-size measurement aids (PSMAs) were not compared with any "true" measure of quantity. The food quantity estimates obtained from the three-dimensional models served as the referent values. One interviewer conducted in-person 24-hour dietary recalls using a predefined and consistent protocol. Subjects were assigned

randomly to use one of the two PSMAs. The same subjects estimated amounts of foods consumed during the previous 24-hour period with the first randomly assigned PSMA, then with the second. Generally, differences in calculated mean energy and nutrient intakes between the two PSMAs were not statistically significant for men or women, leading the authors to purport that the data supports the use of the two-dimensional method for estimation of serving size in nutrition research. However, regarding the study by Posner et al. (1992), Cypel et al. (1997, 291) aptly suggested, "Comparisons of nutrients may have obscured differences between PSMAs in the subjects' estimates of recalled amounts of foods. Greater similarities may be expected when nutrient estimates are compared than when estimates of *quantities* of individual foods are compared, because more variability may be associated with specific foods than with nutrient analysis of aggregations of foods." Closer examination of the actual portion comparisons between the two methods may have elucidated a very different outcome.

Food package labels and containers can also function as serving size suggestions. The label often depicts a photo of the actual amount of the food and lists the intended serving size reference. Consumers who frequently eat specific brand-name foods may be more familiar with the portion-size listed on the nutrition facts label, and can use this as a portion estimation gauge. Similarly, computer graphics are being used to enhance portion estimation. The option to increase or decrease portion representations by using computer software may influence food recall. However, Chambers, Godwin and Vecchio (2000, 896) caution, "The techniques must be studied to be sure that the perception of

size and amount fits with reality."

Food Photographs

Nelson, Atkinson and Darbyshire (1996, 46) found that that misclassification of portion sizes and nutrient intake is reduced when photographs are used in preference to 'average portion sizes'. Conversely, McQuire et al. (2001, 472) suggested that using default volumes for size categories results in portion estimates that are likely to be as or more accurate than estimates using portion size estimation aids (PSEAs) or direct dimension estimation. Faggiano et al. (1992, 379) compared actual weights of foods consumed during a meal to the subjects' next-day recall of food intake as they looked at food photographs. A FFQ and 24-hour recall were developed based on pictures of a series of Italian dishes, intended to allow quantification of the portion size (three pictures each of 21 dishes in an FFQ and seven pictures for each of 23 dishes in the 24-hour recall). The pictures, which represent increasing portion sizes of each dish, were prepared by a professional photographer under highly controlled conditions of light and presentation of the dishes. All of the food was prepared by one of the researchers, and the portion corresponding to each picture was carefully weighed (both raw and cooked). The entire set of seven pictures for 23 dishes allowed the authors to estimate, by analogy, portion sizes for about 120 different food items. This study experienced the "flat slope syndrome" (tendency for low intakes to be overestimated, and high intakes to be underestimated). The researchers found that some foods, including spaghetti, rice, fish and potatoes tended to be underestimated; other foods, including pasta, spinach, and

mixed salad, tended to be overestimated.

Faggiano et al. (1992, 381) observed that rather than a bias in perception, the estimation error in their study was probably a consequence of the range of the picture portion sizes available to the subject. For example, for spaghetti, if pictures available represent food amounts that are smaller than the quantity consumed, then quantities will be underestimated.

A study conducted by Howat et al. (1994, 171) examined validity and reliability of reported dietary intake. The subjects were recruited from a University and research center and trained with food models (control group) or a combination of food models and life-sized food photographs (the experimental group). There were 11 color photos, 16 x 16.5 inches in size, with food placed on a white 10-inch plate, and mounted against a 1-inch black grid. Two unannounced 24-hour recalls were administered, and subjects were required to keep 14-days of food records. The results showed that food photos reinforced memory recall of portion sizes and that reinforcement was retained over an 11-day period. Both training techniques improved the ability of subjects to recall food portions more accurately; however, the food photos "suggest a more dramatic improvement." The greatest errors were found in amorphous and liquid forms of food (e.g. French fries, milk), and the least error was found in solids. The authors concluded, "…form of food can be a factor in the accuracy of estimates of food portion."

Photographic Atlases for assessing food portion size

Nelson and Haraldsdóttir (1998, 231), cited two definitions warranting

clarification. First, a *photograph series* is a set of photographs depicting different amounts of a particular food. Second, a *photographic atlas* is a series of photograph sets, usually bound together in a single volume. The authors also advocated that the distinction between 'portion' and 'serving' is made clear to both researchers and subjects. *Portion* is the amount eaten on any one occasion (first plus subsequent helpings), and *Serving* is the amount of food served in a single helping.

Nelson and Haraldsdóttir (1998, 232) profiled 10 different photographic atlases of food portion sizes. The purpose of the research was to provide practical advice on the development of a photographic series of food portion sizes. The atlases cited were from 7 different countries, the US not included. The publication years range from 1985 (*Annoskuvakirja* from Finland; the inspiration for *Portion Photos of Popular Foods*) to 1997 (*A Photographic Atlas of Food Portion Sizes* from the UK). The number of photo series per atlas ranged from 15 (*Swedish Photographic Atlas of Food portion Sizes*; 1997) to 245 (*Portions Alimentaires* (France); 1994).

The research presented by Nelson and Haraldsdóttir (1998, 231-7) is a benchmark for the development of future photographic aids. Based on extensive examination of other previously published photographic aids, considerations and potential pitfalls are discussed realistically. Main topics include: what to think about before embarking on the development of a new atlas, the format of the photographs, the foods to be included, and the administration of the photographs. Some main points are listed as follows:

· Order of presentation: The most common is from smallest to largest portion size in every photograph series which may lead to bias if subjects classify themselves as 'small' or 'large' eaters and select the extremes of the range. Presentation of photos in random may overcome this problem, though it increases respondent burden substantially and is therefore not recommended.

· The background and use of reference objects: "The background should be unobtrusive and neutral in character". Reference objects (e.g. plate, knife and fork or other cutlery) should be included in every photograph and also provided to subjects as real objects for scale comparison.

· Color or black and white photographs: Nelson and Haraldsdóttir (1998, 235) commented, "In previous research, there was no difference between color or black and white photographs relating to errors in the estimation of portion size. Subjects did report finding the color photographs more interesting to look at which could help promote good rapport and improve concentration in long interviews (e.g. diet history)."

· Foods to be included: Foods that are available in easily identifiable portion sizes should not be included (e.g. individual yogurt). Foods that should be included are those that vary in portion size, range from very small to very large, are irregularly shaped and not available in standardized commercial amounts. These foods are primarily the amorphous foods lacking definitive shape, and also asymmetrical solids. Foods differ in ways that affect how well subjects are able to utilize photographs to estimate portion size (Nelson and Haraldsdóttir 1998, 235). Specific characteristics of foods can influence the

judgment needed to estimate portion size. Nelson and Haraldsdóttir (1998, 235) listed 9 specific characteristics, such as "slippery food" (e.g. spaghetti, other pasta); the judgment required to assess portion size is "Area and depth of food spreading across plate". Another example is: "dry food served in a bowl" (e.g. corn flakes); judgment required: "Area and depth of mound in bowl where much of the food is hidden from view". Also, "discrete pieces of different sizes" (e.g. meat chops, bread rolls, fruit, pieces of potato); judgment required: "volume of irregularly shaped foods; area and depth of pieces"

· Number of foods included in the atlas: This depends on the resources available, the final price purchasers will be asked to pay, purpose of use, diversity of diet, and the degree of cross usability of 'equivalent' foods (foods similar in appearance). Problems with subject acceptability may occur in terms of relating to the visual representativeness of 'equivalent' foods, and also when assessing weights of equivalent foods if food densities are markedly different between equivalents (e.g. bran flakes are much more dense than corn flakes) (Nelson and Haraldsdóttir 1998, 236).

A Photographic Atlas of Food Portion Sizes

Out of the ten atlases presented by Nelson et al. (1998, 232), the UK atlas will be profiled more closely for comparison purposes. As with all photo portion atlases, *A Photographic Atlas of Food Portion Sizes* was designed to help people describe the amounts of food they consume. It is intended for use by dieticians in clinical work, researchers carrying out surveys of diet, and nurses, teachers and others involved in nutrition and health education.

The Atlas, developed by Nelson, Atkinson and Meyer (1997), consists of color photographs of seventy-eight foods commonly consumed by British adults. Each food has a series of eight photographs showing a range of portion sizes from very small to very large. In addition there are photographs showing a range of types and sizes of foods such as fruit, bread and meat and also of crockery, cutlery, can sizes and fluid volumes. The Atlas is accompanied by a User's Guide and associated software to assist in the calculation of food consumption. The User's Guide provides instructions on how to use the Atlas, background information on its development, data on the weights of the foods in the photographs and a questionnaire designed for use with the photographs. The Atlas was developed as a result of substantial research showing that the use of photographs can improve estimates of portion size in dietary surveys. The research and the development of the Atlas was funded by MAFF and undertaken by the Department of Nutrition and Dietetics at King's College London in collaboration with the UK Nutrition Epidemiology Group. Copies of the Atlas and User's Guide can be ordered from MAFF Publications, London SE99 7TP. The cost is £18, converted to US Dollars, is equivalent to $28.84 (CultureGrams, 2003).

Portion Photos of Popular Foods

The *Portion Photos of Popular Foods* (Hess 1997) is a photographic food portion aid published in the US and was designed for use in the community, clinical, research and public health settings. The National Public health Institute of Finland and its portion

book for research titled *Annoskuvakirja* served as an inspiration. The *Portion Photos of Popular Foods* book (referred to throughout as 3PF) can be used as an adjunct to FFQ's, 24-hour recalls, or diet histories. The purpose of the book is: 1) To be used as a tool for assessing food intake, and 2) For use as an instructional guide to teach portion sizes. The book contains 128 laminated pages (12" x 15"), featuring life-size, full-color photos of more than 109 of the most frequently consumed foods in the US. Foods are shown in three portion sizes per page. An advisory board selected foods to be included based on current consumption data and in developing the book, were particularly interested in distinguishing between food exchange, Nutrition Facts label, and Food Guide Pyramid portions of the same food. Of note is that *Portion Photos of Popular Foods* is the first book to identify these differences. Varied serving forms are also included to help respondents identify portions typically consumed to increase assessment accuracy (e.g. a flat slice of cheese *vs*. a block-shaped piece). Five different color blocks aligned in a 1-¼ inch bar by each food serve as a coding tool to decipher between diabetic exchange, Nutrition Facts label, or USDA Pyramid portions. The book was also designed with teaching portion sizes and portion control in mind. The aim was to discern between the 3 portion systems and teach portions within each with consistency. The book also includes photos of standard food measuring equipment and common household dinnerware. Tables of portions shown in volume or measure and weight in grams are included. To date, this is the most extensive resource of its kind in the US. The collaborative research and development panel of 3PF included representatives from the Center for Nutrition

Education at the University of Wisconsin-Stout, the National Center for Nutrition and Dietetics (NCND) established by the American Dietetic Association, the Diabetes Research and Training Center, and the Food and Nutrition board, National Academy of Sciences. The book is available through the American Dietetic Association (ISBN: 0-88091-162-X) for $150.

Current trends in Food Consumption

Major governmental and societal changes have been recommended to reduce the prevalence of obesity (Nestle and Jacobson, 2000). The Center for Science in the Public Interest (CSPI) featured a paper online from the journal *Public Health Reports* titled, "Halting the Obesity Epidemic: A Public Health Policy Approach" (Nestle and Jacobson, 2000) In their article, Nestle and Jacobson urge leaders and community groups to take immediate action. The ubiquity of fast food outlets and soda vending machines, the huge increase in portion sizes in restaurant and an "auto-oriented, TV-watching lifestyle" are all contributing to the current obesity epidemic (2000, 21).

Over-sized Portion Sizes and Estimation Challenges

Research indicates that most people cannot accurately estimate portion sizes of commonly consumed foods (Howat et al. 1994, 170; Guthrie 1984, 1441). Standard portions, as defined by the federal government for the Food Guide Pyramid and the Dietary Guidelines for Americans, are considerably smaller than portions typically consumed by the public (Young and Nestle 1998, 458). Hess (1997, iv) asserts that few people (including experts) can accurately estimate portion amounts and that larger

serving sizes have become the norm with the public covertly encouraged to eat more than what is recommended. Hess further indicates that restaurant portions and even single servings at fast food eateries are often at least twice the "standard" servings identified in the *Exchange Lists for Meal Planning*, the Nutrition Facts label, or the Food Guide Pyramid (1997, iv). Young and Nestle (2002, 246) found that "Marketplace food portions have increased in size and now exceed federal standards. Portion sizes began to grow in the 1970s, rose sharply in the 1980s, and have continued in parallel with increasing body weights."

Current Intake of Starch-Based Foods

The ubiquity of pre-packaged convenience foods has impacted consumers' food and portion choices. The Food and Brand Lab in Champaign, IL has done extensive consumer research looking specifically at brand-name recognition of commercial products and how these influence food and size selection (Food and Brand Lab, 2003). A whole realm of marketing psychology exists behind these brand-name products, with much research devoted to the promotion of bulk-purchases. Wansink investigated overall intake related to larger-portioned snack foods (Wansink, 1996), and observed a direct correlation to increased portion consumption. Most of the additional intake was not consciously accounted for on the part of the consumer. Based on their research, Young and Nestle observed, "The largest excess over USDA standards (700%) occurred in the cookie category, but cooked pasta, muffins, steaks, and bagels exceeded USDA standards by 480%, 333%, 224%, and 195% respectively"(2002, 246).

College target group food consumption trends

Guthrie (1984, 1441) conducted a study with the purpose of "…first determining the amount of food that "apparently healthy, free-living young adults select as a usual portion size and, to second, to assess their ability to describe the food in quantifiable terms, such as common measures or serving sizes". The results demonstrated that it was "evident that the concepts of an average serving size held by these young adults varied considerably and in many cases deviated significantly from commonly used standards". Discrepancies in reporting sizes averaged over 25% from the 'accepted' serving sizes in 50-80% of the breakfast responses, and in 28-67% for the lunch items. Guthrie admonished that deviations of the magnitude presented have important implications for the interpretation of food consumption data and in nutrition counseling.

The college population is also one of the primary groups who tend to prefer convenience, pre-packaged foods. The time-constraints, and lack of preparation facilities often fosters food choices from snack types of foods that have a longer shelf-life and are portable. Because of this prevalence, eating foods that are typically measured out, or require conscious thought with portioning may be limited. Students are often targeted for new products, many of these now experiencing significant gains in portion size. Thus the shift away from formerly known standards has taken a new approach. The Food and Brand Lab (2003) has addressed this target-marketing approach, and gets paid to identify potential niches in the marketplace. Consumers' continued unfamiliarity with standard portion sizes exacerbates the effect these trends have on overall portion-size intake.

Chapter 3

Methodology

Introduction

Methods that quantify food and nutrient intakes of free-living humans may be divided into two broad categories; those in which foods are weighed directly, and those in which food quantities are estimated (Robson and Livingstone, 2000). Both methods have their strengths and limitations. Although weighing is deemed more precise, the advantage of the estimation method is that it can be administered by trained investigators over a relatively short period of time and avoid the pitfalls of subject burden, financial and time costs. Robson and Livingstone (2000, 183) noted that the success of these methods depends heavily on the ability and willingness of subjects both to remember and accurately estimate the amounts of food consumed. Previous research has established that accurate portion size estimation is problematic. Visual aids, such as food photographs, may help to improve the accuracy of food quantification. The *Portion Photos of Popular Foods* book (3PF) (Hess, 1997) fits into this photographic aid category. The book contains 109 life-sized color photographs of commonly eaten American foods. Each food is depicted in several portions sizes and forms adding up to over 350 food serving sizes. The book was developed with careful attention to differences between food exchange, Nutrition Facts label, and Food Guide Pyramid portions of the same food.

The purpose of this study was to compare portion sizes reported during a 24-hour

recall *without* the use of a photographic aid to those reported *with* the 3PF photographic aid for starch-based foods. Three key factors were examined to evaluate the impact a photographic aid has on portion-size estimation: 1) to differentiate between reporting trends (over-, under-, and exact-reporting), 2) compare demographic information to these trends, and 3) evaluate if any food-specific problems exist contributing to estimation difficulties.

Research Design

This study is a descriptive study designed to compare serving sizes reported during a 24-hour recall without the use of a photographic aid to those reported with the 3PF photographic aid for carbohydrate dense foods. The results will contribute to improving current portion size estimation techniques and provide suggestions for re-evaluating current methods.

Protection of Human Subjects

The Institutional Review Board (IRB) for the Protection of Human Subjects in Graduate Research at the University of Wisconsin-Stout approved this research study (Shown in Appendix B). In addition, IRB approval was obtained to conduct a pilot study. Confidentiality was maintained throughout both studies with all identifying information replaced by ID codes that could not be linked to the original subject. Subject involvement was strictly voluntary. The primary consent form (Shown in Appendix B) was used for both the pilot study and the main study. As noted on the consent form, participation was strictly voluntary and could be discontinued at any time without

prejudice. Also that strict confidentiality would be maintained during the study**.** In addition to the main consent form, a second consent form (Shown in Appendix B) was developed to videotape some of the pilot study interviews.

Instrument Development

The instruments utilized in this research project were a demographic survey, and the Food Record data form (Shown in Appendix A) for recording 24-hour recall (24R) amounts and *Portion Photos of Popular Foods* (3PF) selections. These two forms were printed back-to-back so that it was less cumbersome for the researcher and would not interfere with the interview process. The form was printed on 8 ½" x 14" (legal-size) paper and listed the Subject ID codes on the top line followed by demographic information questions. The Subject ID codes replaced subject names to ensure confidentiality. The cited codes were based on the diet interview date, time, and chronological subject number, e.g.) 416090001; which translates into, April 16th, 9 AM, 1st interview of the day. This system helped track the dates and times of the diet interviews and ensured subject anonymity. Besides the ID codes, demographic data were collected as follows:

- Age
- Height
- Weight
- Any previous nutrition class?
- Major
- Day and Date of the week recalled
- Any medical problems that may have caused a change in diet?

The reverse side consisted of the Food Record collection form used for recording 24R and 3PF information. The Food Record went through two phases during the pilot study before the final form was developed. Columns were added for concise 24-hour recall notation, for recording the photo-portion amount selected and to record gram conversion calculations. In addition, columns for citing the reference page number and for calculating the difference between the two reported values were added.

Pilot Study

Data Collection

Before the main study could take place, a pilot study was designed to provide both practice for the researcher and to refine interviewing techniques and research logistics. Several diet interview sessions were videotaped for further critiquing and feedback from the researcher's graduate program advisors.

Pilot Study Subject Recruitment

Fifty-two undergraduate students enrolled in a "Nutrition for Healthy Living" course at the University of Wisconsin-Stout consented to participate in the pilot study termed the *Diet Interview Project.* These students were non-nutrition majors taking an elective general nutrition class. Students were recruited from two separate class sections and given a brief verbal explanation by the researcher regarding the nature of the project, the time involved and the location of where the session would take place. It was specified that no prior preparation was needed, and that the objective of the study did not

focus on evaluating diets for nutritional adequacy. No clues were given regarding the 24-hour diet recall method or information about the use of any additional assessment tools. Students were informed that the person conducting the interviews was a UW-Stout graduate student in Food Science and Nutrition working on thesis research. The students voluntarily signed up on an appointment sheet for a specified date and time that fit into their schedules. Participation would be rewarded with 5 extra credit points.

Pilot Study Data Collection

The pilot study was launched in order to practice conducting the 24-hour dietary recalls in a controlled environment. The pilot study sessions were conducted on February 26, 27, March 5, 6, 19 & 20, 1998 in classroom 240 in the College of Human Development at the University of Wisconsin-Stout. This classroom was specifically chosen because it offered privacy, comfort, adequate lighting, was familiar to the researcher, and it was available for the scheduled times needed. Of the 52 students who signed up to participate, 31 completed the 24-hour diet recall. These interviews contributed to development of skills and expertise necessary to ensure efficient and unbiased data collection. Video-recording eleven random sessions on March 19 and 20 facilitated this process. The researcher cued the video recorder attached to a tri-pod stand. No other person was present to potentially influence the responses.

Pilot Study Feedback

During a meeting held on Thursday, April 2nd, 1998, three-experienced faculty members critiqued the video-recorded 24-hr diet recall/3PF interviews and offered

suggestions for technique and content adjustments. Recommended suggestions were: keep words to a minimum, probe for specifics related to food amount, e.g.) using the ruler for diameter, use brand names for foods not in the book—e.g.) granola bar, candy bar, type of fast food burger, etc. Other considerations included: avoid opinions, keep in mind that the aim was not to educate, and refrain from leading statements. It was further suggested to place the 3PF book flat between the researcher and the participant so that the participant had a "table view" of the pictures. Recommended changes were incorporated during the diet interview sessions held on April 14th, 1998. Four sessions were videotaped for further critiquing and confirmation of improved technique utilization. Once advisory approval was obtained, participant recruitment for the main study commenced.

Main Study

Data Collection

Subject Recruitment

Upon successful completion of the pilot study diet interviews, the main study could begin. The study population consisted of undergraduate students in non-nutrition majors who were attending the University of Wisconsin-Stout between April and July 1998. Non-nutrition majors were chosen in order to prevent adding another variable to the study that could influence the study outcome. That variable would include training and familiarity with cooking techniques and portion size measurement as required within

the coursework for Dietetics and Hotel and Restaurant majors. Such training would bias the responses of the participants and thus potentially invalidate study outcomes.

Incentives as extra credit points were marketed to encourage student participation. UW-Stout faculty members teaching courses in Business were contacted by the researcher via a phone call or in person and asked for their assistance. Throughout the course of the main study, three faculty members were contacted and all agreed to let their students participate in the research. In addition, their further agreement to offer extra credit points provided the needed incentive to encourage sign-up (Appendix C).

Students for the main study were solicited from four university classes, one during the Spring semester and three consecutive classes held during the summer.

Table 1. Recruitment Pools and Interview Schedule

Class	When offered	Class start/end date	Diet Interview dates
Exploring Technology	Spring semester	January 22-May 17	April 16, 17, 23, 24
Exploring Technology	Summer course	June 15-July 10	June 25, 29, 30; July 1,2
Principles of Marketing	Summer course	June 15-July 10	July 1, 2, 6
Principles of Marketing	Summer course	July 13-August 6	July 21, 22, 23, 24; Aug 4

The first faculty member approached for assistance in student recruitment taught an Exploring Technology class. The class was divided into study group sections and met on different days during the week. This professor promoted the opportunity to gain 10 extra credit points to the various sections and allowed students to sign-up throughout April 6-15, 1998. The second faculty member, who taught the Exploring Technology summer course, invited the researcher to talk to his class, explain the general purpose of

the research, solicit volunteers and promote the 10 extra-credit points he would award each participant. The third faculty member taught two summer course sessions of Principles of Marketing. Again, the researcher went to the classes in person, explained the generalities of the research being conducted and encouraged participation. As before, extra credit points were offered.

Procedures

Interview Procedure

The general procedure of the interview process started with an exchange of greetings. The investigator moved toward the desk (office layout described in Table 2) and indicated to the participant where to be seated and which way to face.

Table 2. Location and Setting

Place	Home-Economics Building—Office 245
Layout	▪Large vertically-aligned desk positioned on the left-hand side of the office ▪Two large comfortable brown padded office chairs facing the desk ▪An extra chair was present to accommodate another person if needed (e.g. an accompanying child)
Lighting	▪Bright fluorescent ceiling lights
Environment	▪Professional in appearance ▪Books & binders stacked neatly on 3 shelves hinged on wall above desk ▪Muted neutral color scheme promoting ease of mind ▪No distracting paraphernalia on walls or surroundings to bias responses

After a brief introduction, the investigator described her qualifications and provided general information about the questions to be asked of the participant during the session. Two forms were obtained from a shelf directly above the desk. The first was the consent form, which was reviewed with the participant. Signatures were obtained prior

to proceeding further. The 2-sided long form was presented next with the request that the subject complete the demographic survey.

The 24-hour Recall

The investigator explained that during the interviewing session, information would be gathered via what was commonly referred to as a "24-hour recall". It was further explained that this data collection method was being used to get a general idea about foods and amounts commonly eaten on a given day. It was emphasized that the reported intake would not be judged based on nutritional adequacy, nor the strengths or limitations of the diet. Next, the participant was informed that following the 24-hour recall, another tool would be used to collect some additional information.

The investigator requested that the student report all foods consumed the day before, starting with the first thing eaten in the morning to the last food/beverage consumed before bed-time & to include all snacks *including* anything consumed *during* the night. The importance of accuracy was also stressed. Students were encouraged to describe the portion size consumed by estimating in terms of common measuring sizes. If the food could not be measured in terms of cups or ounces, it was recommended to describe the size of the food (e.g. banana) & measurements would be taken with a ruler of the size demonstrated by the student. It was explained that by obtaining the size through taking measurements—a weight or gram equivalent could be calculated. After subject' 24-hour dietary recall completion, the 3PF book was presented. Recall responses for 3PF pictures available were re-examined. The subject was requested to select the

pictorial resemblance that most closely matched the food formerly reported. If the amount was uncertain, or was not depicted, the student could state more or less than, or combine any of the three portion photos shown.

Portion book pages were recorded by keeping a copy of the table of contents near the record sheet for the 24-hour intake foods. The researcher added the 3PF book page numbers on the data form while the participant thought about other foods consumed. Clarification and expansion of reported amounts was often required and this was done at the end of the reported 24-hour recall. Without introducing any bias, the student was encouraged to think about any additional condiments, beverages or the method of cooking used, which may have been overlooked when initially reporting the main entrees consumed. Examples include: "Did you put anything on your toast?"; "Did you have anything to drink with your Lunch?"; "How was the fish prepared?--fried, or baked?". Ideally, 24-hour recall data and 3PF calculations were completed after each session, but if scheduled appointments were back-to-back, calculations were done at the end of the day. A full 24-hour recall was completed for each subject. However, only starch-based food findings from the 24R were assessed for this study.

Statistical Analysis

All data were analyzed using SPSS version 11.0 (SPSS Inc. 2001). Demographic information and grain-based foods intake were examined using descriptive statistics such as frequencies, measures of central tendency, and percentages. Paired-Samples *t*-tests were used to assess the difference in 24R, vs. 3PR. Independent sample *t*-tests were used

for gender. Frequencies data analyzed gender specific reporting trends: inter-, intra-, and total. Chi square analyses were used to test the association between over, under and exact portion reporting to gender and to body mass index. Pearson's correlation coefficient was used to assess the association between total difference and the variables weight (lbs) and age. Though SPSS was used as the primary statistical analyses program, the researcher, with the assistance of a statistician, also conducted comparative analyses using the Statistical Analysis System (SAS) Version JMP (SAS Institute Inc., Cary, NC, 2002). For the purpose of this study, statistics with a probability of less than 0.05 were considered significant.

Calculating the 24R and 3PF portion reports

The primary researcher closely examined each starch-based food, calculated the reported data and compared each response to the selected photographic depiction in gram weights. Often this differentiation required additional calculations and conversions in order to make a fair comparison to *volume* and not *density* for 'fair portion' comparisons (e.g. a report of 1 Cup "raisin-bran" (actual density wt.: 55g; the picture representation selected was 1 Cup "corn flakes" (actual density wt: 30g). The portion selected matched the portion reported, however, if the cereal type was not converted to equal portion representation, it would depict a false report. This process was applied to all of the reported grain-based foods and required extensive deliberation, justification, and professional judgment on the researcher's part. The interpretation and conversion criteria were logged in the *Rulebook* and detail the extent of care taken to ensure consistency in

data analysis (Appendix F). For each food, what was calculated was documented to ensure that the data have integrity. The future projection of this attention to detail is that it will assist continued research in the area of improving photographic measurement aids. As noted, reports for each starch-based food were converted to gram weights to obtain the degree of error in estimation. The portion gram amount of foods *reported* via the 24-hour recall (24R) were subtracted from the portion *selected* from the *Portion Photos of Popular Foods* (3PF) the standard, or reference value. The accuracy of quantity estimation was further assessed by examining the proportion of foods over-, under-, and accurately estimated, and by looking specifically at differences between foods. The researcher also recorded comments made by the subjects in reference to observations or problems in portion-size selection that could be used for future 3PF revisions.

CHAPTER 4

Results

Introduction

The demand for accurate dietary information is growing. Chambers, Godwin, and Vecchio (2000, 891) note that government, academic and industry groups have vital interests in determining how much people eat of various foods. Elucidating this information is important because it directly impacts dietary assessment, influences food and health policies, gauges exposure to environmental risks associated with food, enhances understanding of new food product consumption, and aids in forming population-based and high-risk strategies for health promotion and disease prevention. One of the primary means of collecting this information is national surveys such as the Continuing Survey of Food Intakes by Individuals (CSFII) and the National Health and Nutrition Examination Survey (NHANES) (Thompson and Byers 1994, 2255S). Research conducted in clinical settings contributes to refining dietary recommendations and consumption trends, monitored by food companies, also influence market shifts in food production and promotion (Chambers, Godwin and Vecchio 2000, 891).

Researchers have often found that dietary recalls are wrought with inconsistencies. Dwyer (1999, 943) effectively presented the advantages and disadvantages of different dietary assessment methods. Which method to select depends on what type of information is needed: past intake (retrospective), intake to be collected after the instruction (prospective), or a combination of the two. Retrospective methods

include the 24-hour recall, food frequency questionnaires, and dietary histories (Dwyer 1999, 941). This study employed the 24-hour recall (24R) to collect data on portion-size estimation from college students. Information obtained from each subject during a re-examination of the reported foods utilizing the *Portion Photos of Popular Foods* (3PF) (Hess 1997) book was compared to the initial reported recall. The purpose of this study was to enhance the validity of dietary assessment methodology by assessing the impact of a photographic aid on portion size recall. Specifically it sought to: 1) differentiate between reporting tendencies (over-, under-, and exact-reporting) comparing 24R to 3PF, 2) compare demographic information to those outcomes, and 3) examine the data for any food-specific recall difficulties. Although an entire 24-hour recall (24R) was completed for each subject, the grain group was selected as the focus for analyses for this study. Inclusive were the breads (including starch-based snacks and mixed foods, e.g. chips, pizza, submarine sandwich), cereals, and starchy vegetables.

Recruitment Pool Outcomes

Of a total of fifty-six students from the 1st Exploring Technology group, thirteen students (23%) missed their appointments. Forty-three students (77%) completed the 24R and 3PF interviews, April 16th through April 24th, 1998. From the 2nd Exploring Technology group, out of 18 people who signed-up, 15 (83%) completed the 24R and 3PF data collection sessions between June 25th and July 2nd. Finally, from the 3rd group of students, two Principles of Marketing classes provided 99% and 100% participation respectively for a total of 18 from the first class (only 1 no show) and 17 from the second

between July 1st and August 4th, 1998.

Description of Subjects

Ninety-three students total, from 33 distinct non-nutrition majors, completed the 24R interviews. The group was composed of 42 males (mean age 24 years) and 51 females (mean age 22.7 years). The average BMI for males was 26.04 (SD 5.35) and for females, 23 (SD 7.7).

Diet Interview Sequencing

The appointments were made based on 30-minute time slots. The diet interviews averaged 20 minutes to complete and took place over the course of 15 non-consecutive days. The time needed to complete the interviews varied based on total intake and often depending on the number of pre-packaged, convenience food items consumed. Generally, the higher the incidence, the less time it took because rather than quantification, these items were single serving foods reported by count. The number of subjects interviewed per day ranged from a minimum of 1 to a maximum of 15 with an average of 6 interviews per day. The *highest* incidence of interviews scheduled back-to-back without a break was 6; the *average* incidence for back-to-back scheduled appointments was 3 sessions.

Starch-based Food Reporting Incidences per Subject

Out of 37 grain-based foods pictured in 3PF, thirty (81%) foods were identified during the 24Rs. A total of 181 starch-based food comparisons were reported (106 in females (59%), 75 in males (41%)). The total number of grain foods reported per subject

ranged from 0 to a maximum of 4. Out of 93 subjects, thirty-eight (40.9%) reported two grain-foods during the interviews. The next highest incidence was 3 foods per subject as reported by 25 individuals (26.9%). Twenty-four percent of the group (22 recalls) reported only 1 grain-food. Two subjects consumed 4 grain-foods (2.2%) and six subjects did not report any grain-group foods.

Reporting Frequency Delineation and Direction

Sixteen of the 30 grain-foods were reported by four of more people, (Table 3) for a total of 85% of the recalls (153 incidences out of 181). The remaining 28 recalls (15%) consisted of 1–3 subjects per reported grain food (14 total).

Table 3. Starch foods reported with greatest frequency and direction (over/under/exact)

Food	Frequency	Over	%**	Under	%**	Exact	%**
*Ready-to-Eat Cereal	29	6	21%	15	52%	8	28%
*Spaghetti	17	13	76%	3	18%	1	6%
*Pizza	16	2	13%	4	25%	10	63%
*Tortilla Chips	13	5	38%	7	54%	1	8%
*Bagel	10	5	50%	2	20%	3	30%
*Rice	9	3	33%	2	22%	4	44%
*French Fries	8	7	88%	1	13%	0	----
*Pasta Salad	8	5	63%	3	38%	0	----
Baked Potato	7	2	29%	2	29%	3	43%
Submarine Sandwich	7	1	14%	1	14%	5	71%
Crackers	6	3	50%	1	17%	2	33%
Hot Dog Bun	6	0	----	0	----	6	100%
Cookies	5	0	----	4	80%	1	20%
Corn	4	4	100%	0	----	0	----
Macaroni & Cheese	4	1	25%	1	25%	2	50%
Potato Chips	4	3	75%	0	----	1	25%

*Denotes the eight foods reported with a frequency of ≥8
**Note: percentages may be off by 1% due to rounding

Directional frequencies based on incidence of over-, under-, or match reports

The eight foods with the highest recall frequency from Table 1 were compared to standard portion size. Three graphs were created to illustrate the greatest incidences of over-, under-, and exact (or match) reports for these foods. Each figure shows the representative foods that demonstrated a greater number of over-, under-, or exact reports. It should be noted that with each food item shown, though there were a greater number of reporting incidences in 1 direction, there were also reports for the other 2 directions, e.g.) spaghetti had a high incidence of over-reporting compared to the standard, but there were also, though less proportionally, recalls that were less than or equal to the standard. Figure 1 depicts the foods most frequently over-reported compared to the 3PF standard, Figure 2 demonstrates those foods most often under-reported, and Figure 3 shows the foods with greatest incidence of matched portions.

Figure 1. Foods with the greatest incidence of over-reporting by 24R relative to 3PF photo portion

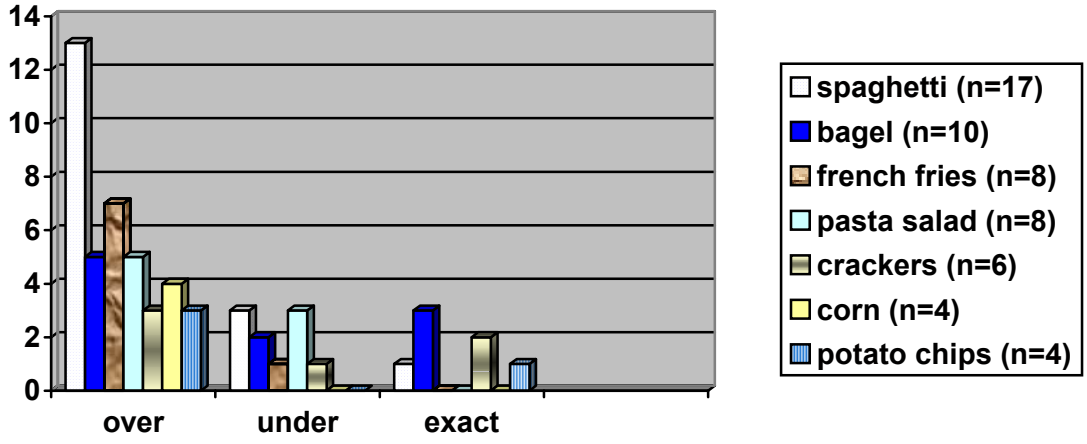


Figure 2. Foods with the greatest incidence of under-reporting by 24R relative to 3PF photo portion

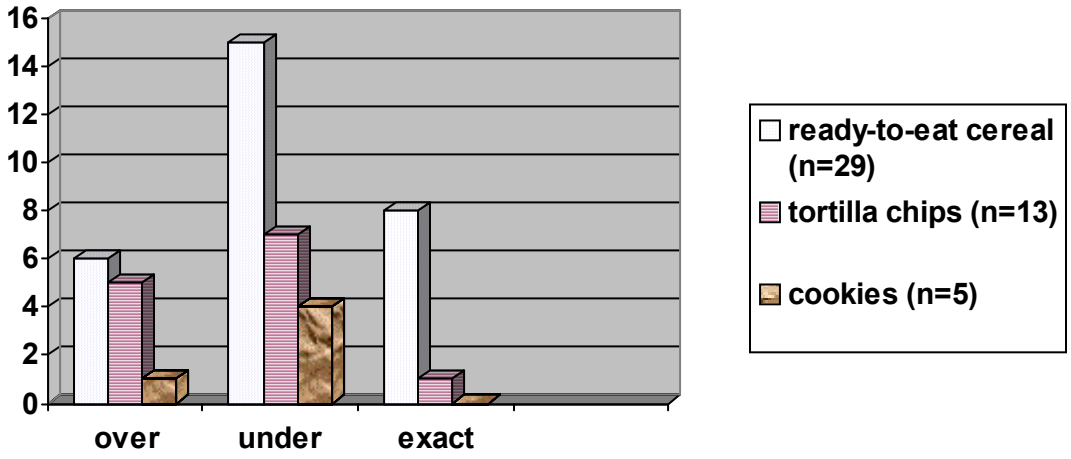
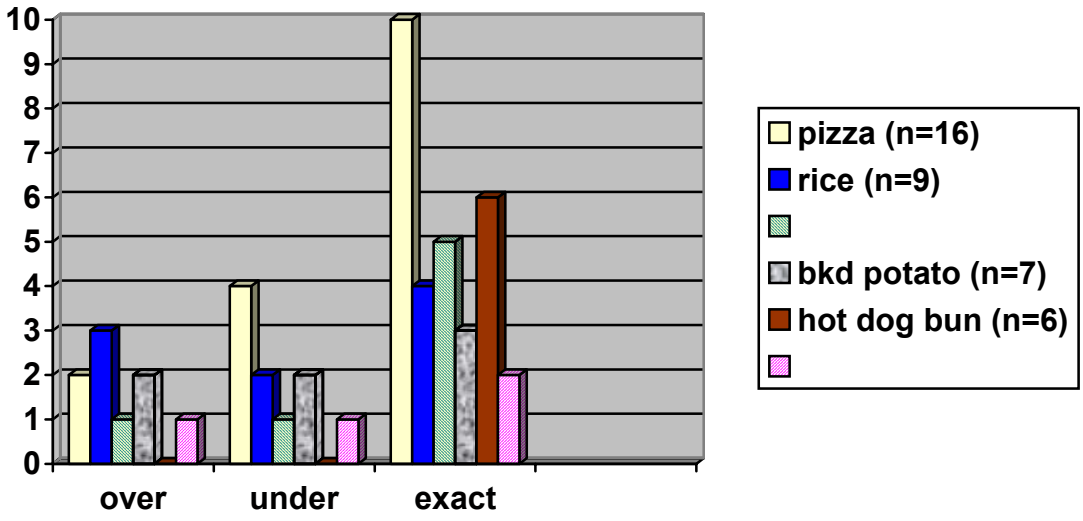


Figure 3. Foods with the greatest incidence of exact portion size match between 24R and 3PF.



Differentiation between reporting tendencies and demographics

Out of 181 recall comparisons, the incidence of over-report accounted for 73 of the

responses (41%); under-reports equaled 55 responses (30%) and exact reports totaled 53 (29%). Over, under or exact reporting incidences were evenly distributed (Chi sq. 4.02, df=2, p=0.134) among all 181 comparisons as well as for males alone (Chi sq. 1.04, df=2, p=.595), or for women alone (Chi sq. 4.32, df=2, p=.115). Over, under or exact reporting incidences were not associated with gender (Chi sq. .57, df=2, p=.75) or whether or not the participant had a body mass index ≥25 (Chi sq. 1.23, p=.54) (Table 4).

Table 4. Comparison of reporting differences to gender and BMI

			BMI	
DIFFERENCE TYPE*	Male**	Female	<25.1	≥25.1
No difference	24	29	39	13
Over report on 24 Hour Recall	30	44	52	18
Under report on 24 Hour Recall	21	33	42	9
TOTAL	75	106	133	40

* Chi Square between difference type is 4.02, p=.134
** Chi Square between difference type and gender is .57, p=.75
***Chi Square between difference type and BMI categories is 1.23, p=.54
(note: totals differ due to missing weights)

For each subject, the total grams reported for all foods by both methods (24R and 3PF), as well as the difference in total grams between the two methods, was calculated. Pearson's correlation coefficient was used to assess the association between reporting difference for total reported vs. total selected (for total difference), and the variables weight (lbs) and age. There were no significant associations between total difference and age (r=0.0679, p=0.5180) or between total difference and weight (r=-0.0524, p=0.6257).

Foods Reported with Greatest Frequency and Discrepancy Range

Mean and median differences between 24R and 3PF values (3PF minus 24R) for the foods reported with greatest frequency were examined for minimum, maximum and

range of variation (Table 5). Foods are listed in order of greatest reporting frequency with the number of reports (n=) cited next to each food item.

Table 5. Mean difference and discrepancies between 3PF and 24R

Food	n=	Mean Difference	Median Difference	Range of Differences(g)	Minimum Discrepancy(g)	Maximum Discrepancy(g)
Cereal	29	9.34 (SD=18.4)	5	75 (-25 to 50)	0	50 (under-rep)
Spaghetti	17	-98.35 (SD=159.5)	-87.0	661 (-358 to 301)	0	-358 (over-rep)
Pizza	16	38.4 (SD=126.7)	0	548 (-68 to 480)	0	480 (under-rep)
Tortilla Chips	13	14.5 (SD=35.6)	6	113 (-28 to 85)	0	27 (over-rep)
Bagel	10	-2.70 (SD=9.88)	-3.5	28 (-14 to 14)	0	14 (over & under)
Rice	9	-22.33 (SD=102.2)	0	385 (-245 to 140)	0	245 (over-rep)
French Fries	8	-39.5 (SD=42.7)	-39.5	124 (-113 to 11)	0	113 (over-rep)
Pasta Salad	8	30.4 (SD=166.7)	-55.5	565 (-314 to 251)	43 (over-rep)	314 (over-rep)
Baked Potato	7	-15 (SD=47.2)	0	135 (-90+45)	0	-90 (over-rep)
Submarine Snw	7	3.80 (SD=55)	0	189 (-81 to 108)	0	108 (under-rep)
Crackers	6	-5.17 (SD=14.7)	-4.0	41 (-23 to 18)	0	23 (over-rep)
Hot Dog Bun	6	0	0	0	0	0
Cookies	5	61.4 (SD=45.5)	61	114 (0 to 114)	0	114 (under-rep)
Corn	4	-70 (SD=21.6)	-65	-50 (-50 to –100)	0	100 (over-rep)
Mac & Cheese	4	7.25 (SD=72.7)	0	177 (-74 to 103)	0	103 (under-rep)
Potato Chips	4	-10 (SD=11.8)	6.5	27 (-27 to 0)	0	27 (over-rep)

Food-Specific Reporting Difficulties

One of the objectives was to consider potential food-specific problems that impact a subjects' ability to quantify a recall portion. One-third of the portion from the actual amount is significant relative to portion size. Foods reported four or more times that most frequently demonstrated a 1/3 portion over from the 3PF standard included

spaghetti, tortilla chips, ready-to-eat cereal, pasta salad, French fries and cookies (Table 6).

Table 6. Foods with over 1/3rd (>33%) portion discrepancy from 3PF (the Standard) for starch-based foods. Data are presented for foods with 5 or more observations (n=≥5).

Food	N=	1/3 Over	%	1/3 Under	%
Spaghetti	17	9	53%	2	12%
Tortilla chips	13	4	31%	6	46%
Cereal	29	2	7%	5	17%
Pasta salad	8	4	50%	3	38%
French Fries	8	6	75%	0	---
Cookies	5	0	---	4	80%

Seventy-eight observations total (including those with less than 5 observations per food) demonstrated a greater than 1/3-portion discrepancy from the 3PF standard; 50 over-, and 28 under-reporting incidences for 64% and 36% respectively. One-third of the portion from the actual amount is significant relative to portion size.

Upon close examination of the comparisons (24R vs. 3PF) and the starch-based foods most frequently recalled, the outcomes did not suggest that absolute portion size or range of portions photographed for a food were related to direction of difference (over-, under-, or exact reporting). However, there were significant differences noted for specific foods. Large discrepancies of over 100 grams were noted in both directions (over-, and under-) for spaghetti, and pasta salad (see Table 3). In addition, the mean was analyzed for each individual food to examine if there was a significant difference between 24R and 3PF. Foods for which there was a significant difference between 24R and 3PF for n≥ 8, included: cereal ($p=0.0128$), spaghetti ($p=0.0218$), and French Fries ($p=0.0149$). Of note are that all of these foods fall into the "amorphous" food category.

CHAPTER 5

Discussion, Conclusions, Recommendations

Introduction

The prevalence of overweight and obesity has increased sharply among US adults and children in recent years. Although multiple factors can account for weight gain, the basic cause is an excess of energy intake over expenditure (Young and Nestle 2002, 246). Levine et al. (1999, 212) specifically examined the effect increased energy intake had on weight gain. Specifically, the study looked at the human biology of energy intake and expenditure and how this complex biological system attempts to maintain a person's body weight or, in many cases, when it goes awry. The impetus behind the research is fueled "by a nation whose girth continues to expand at unprecedented rates." The researcher recently stated that "it is costing this country an astonishing $120 billion per year" (Walker, 2003). The obesity epidemic and increased food portion consumption makes it clear that efforts need to be directed to educating the public on selecting and consuming smaller portion sizes appropriate for their energy needs (Young and Nestle 2003). Some of the tools used by dietitians for portion-size assessment are portion-size measurement aids. As previous research has repeatedly demonstrated, portion-size estimation remains wrought with inconsistencies and challenges in determining 'actual' intake. The general public has great difficulty discerning appropriate portion sizes, which warrants the need for additional research. This study examined the impact a

photographic aid has on portion-size estimation with aim to enhance the validity of dietary assessment methodology. Instruments were developed to collect demographic and portion-size recall information to assist in determining differences and associations. Study subjects were recruited from four classes at the University of Wisconsin-Stout; ninety-three subjects participated. Data were collected and results were analyzed to achieve the primary objective of comparing 24-hour recall (24R) portion sizes to *Portion Photos of Popular Foods* (3PF) selected portions. Other objectives of this study were to: 1) differentiate between reporting tendencies (over-, under-, and exact-reporting) comparing the 24R to 3PF, 2) compare demographic information to that stratification, and 3) examine the data for food-specific variations. Demonstration of improvement in portion-recall estimation with the utilization of a photographic aid could contribute to improving current dietary assessment practices.

Discussion

As commented by Robson and Livingstone (2000, 191) "the effect of subject characteristics on reporting ability has been a matter for some debate". One of the objectives of this study was to compare demographics to reporting difference. Consistent with other research studying portion-size estimation and gender (Robinson et al.1997, 122; Robson and Livingstone 2000, 191), this study showed that there does not appear to be any difference in ability to estimate portion size in any direction (over-, under-, or exact) or between males and females. In fact, no differences were shown in the reporting tendencies for males, females, or the entire sample. There was also no association

between age and portion difference. However, Nelson, Atkinson and Darbyshire (1996, 31) suggested that age, sex and body mass index (BMI) were potential confounders when subjects used eight portion size photographs of each food to estimate amounts consumed. In contrast, Robson and Livingstone (2000, 191) cited an Italian study that suggested that age is not an important predictor of ability to estimate food quantity and others have concluded that level of education is also unimportant.

As with Robinson et al. (1997, 122), the subjects in this particular study cannot be said to be a representative population because of the narrow range of ages and occupation (all were students). Subjects were selected from a University campus with a mean age of 23.4 years and a variety of educational backgrounds. They formed a typical cross-section of University college students. As observed by Nelson, Atkinson and Darbyshire (1996, 43), "While it cannot be said that the sample was representative of the population generally, it seems unlikely that subjects living in *London* (or Menomonie, WI) would differ in their perception of food-portion size from subjects living elsewhere in *Britain* (or the United States). In this case, it is generalized that food portion estimation similarities would exist between students at UW-Stout and another University.

The first objective was to examine reporting differences. No significant differences in direction of reported differences were demonstrated as a function of gender, or BMI. However, as with previous research (Robinson, 1997, 122; Nelson, Atknison, and Darbyshire 1994, 658), this study had a large range of both over- and underestimation. Upon closer examination of individual foods, significant variations

were noted. For example, in this study, spaghetti experienced the widest range of reporting discrepancies, from 358 grams over-report to 301 grams under-report with the range of discrepancies totaling 661 grams. Similarly, pasta salad discrepancies ranged from 314 grams over-report to 251 under-report with the discrepancy range equal to 565 grams, and rice discrepancies ranged from 245 over-report to 140 grams under-report with the range equaling 385 grams. Spaghetti, pasta salad and rice were significantly over- and under-reported by greater than 100 grams. Other foods reported by at least four subjects that had incidences of 24-hour recall portions *smaller* than the photo portions by at least 100 grams were pizza, French fries, macaroni and cheese, cookies, and submarine sandwich. Additionally, corn was reported *greater* by at least 100 grams from the photo portion.

Portions were more comparable for single items of foods such as a bagel, or baked potato and also foods where a known amount could be recalled, for instance, pizza slices. The problem with the pizza slices is that often the slices reported were the grocery store frozen variety. The subject demonstrated the size of the slice(s) reported with their hands, which was measured with a ruler. For comparison purposes, the number and type (thick, or thin crust) had to be simplified (e.g., selecting two medium slices, for two medium slices reported), because of non-representative photographs and because sizes were not included in the 3PF book, only ounces. Two slices of thick-crust take-out Supreme-style pizza, vs. 2 slices of grocery store frozen pizza would vary significantly if the comparisons were based on weight vs. number of slices reported.

. The presence of a 'flat slope' syndrome has been reported (Faggiano 1992, 381; Nelson, Atkinson and Darbyshire 1994, 660; Guthrie 1984, 1440), where large portion sizes tend to be underestimated and small portions tend to be overestimated, thus contributing to an overall average of no difference. Dwyer (1999, 943) noted this as an inherent error with the 24-hour recall dietary assessment method. However, because this study did not include a weighed 'known' reference amount, it cannot be assumed to have occurred here. Reporting accuracy of the 24R is known to be at fault, so whether the initial reporting was over- or under-estimated vs. or the portion selected from 3PF is unknown. The compound error in itself may have averaged out the results. Nelson, Atkinson and Darbyshire (1994, 660) commented that although there was evidence of the 'flat-slope' syndrome, the error was greater using a single 'average' photo for assessment vs. using eight photographs. The inclusion of more than one photograph appears to improve portion size recall.

Chambers, Godwin and Vecchio (2000, 891) reported on specific cognitive strategies that enable the subject to retrieve a memory, conceive of a quantity, and describe the amount. This process in reality passes through these 3 distinct filter systems, all of which without former training can compromise reporting accuracy. Each step may introduce significant error. Robinson et al. (1997, 122) compared portion-size estimation for 2 foods (corn flakes, and mashed potatoes; served, and separately, self-served; neither consumed), on 100 university students and found that there was a large range of both under- and overestimation, whether foods were served or self-served. The subjects

estimated portion size immediately after viewing the foods so an assumption might be that the diminished return of memory would not be affected. Warranting inclusion is that "the range of errors appeared to be considerably different between the two foods used in this study, suggesting that not all foods are equal in terms of peoples' ability to estimate portion sizes". This conveys agreement with what was noted for this study and addresses the third objective, which sought to examine food-specific issues in portion estimation. Similarly, Robson and Livingstone (2000, 190) found that many of the foods used in their study showed a distinct bias towards either over- or under- estimation of quantity. This supports earlier observations that perception problems exist with certain photographs, suggesting that the general pattern of errors associated with particular foods may be due more to their presentation in the photographs rather than to specific subject characteristics (Robson and Livingstone, 2000, 190). It was noted by Chambers, Godwin and Vecchio (2000, 895) that similarly sized objects or shaped objects could more easily serve as cues for memory recall than objects that might hold the same amount but look different. Likewise, food photographs may facilitate food portion selection if a like-photo exists, but conversely, introduce error without a mirror image.

This study identified several food specific problems related to mis-estimation of portion sizes. Based on recall frequency and reporting direction for the eight foods most frequently reported, spaghetti, pasta salad, tortilla chips, and French fries recalls were inaccurate, accurate for pizza and bagels, and ambiguous for ready-to-eat cereal and rice.

The amorphous group has previously been identified as difficult to ascertain

(Leachman-Slawson and Eck 1997, 295; Howat et al. 1994, 172), and warrants closer examination to assist the quantification process. "Amorphous" is defined as 'having no definite form' (Merriam-Webster, 2003). In this study, spaghetti experienced significant discrepancies in under- *and* particularly, over-reporting. Current food-model aids do not include similar representation of spaghetti, (or pasta-type foods), depicting both the actual 'loft', or the volume, spread out on a plate. Current pliable plastic models (e.g. Nasco brand, 2003) resemble a cemented mound, not too dissimilar in appearance to mashed potatoes with the exception of lined markings. Similarly, current food photographs fail to portray the 3-D effect helpful in better assessing 'actual' intake.

Other foods for which respondents had difficulty quantifying in this study were tortilla chips, potato chips and French fries. The amorphous shapes were problematic to conceive of, and often the specific quantity consumed was not consciously noted to begin with. Chambers, Godwin and Vecchio aptly reported, "no aid will help to recall amounts that never entered memory" (2000, 896). The authors further quote a study, which suggested that up to 30% of food memory may be lost from the previous day. Food photographs could be useful by providing a default visual depiction of a small, medium, or large portion size. This method presumably would be "as accurate as asking respondents to guess portion sizes they clearly do not know"(Chambers, Godwin and Vecchio, 2000, 896).

Nelson, Atkinson and Darbyshire (1996, 32) cited 10 studies that have reported benefits of using photographs to help subjects assess portion sizes. The authors quote

that "it is clear that the nature of the assessment will influence the outcome of the study." The assessment portion was critical in this study and is reflected in the process undertaken to ensure precise and representative data calculations. The primary researcher closely examined each starch-based food, calculated the reported data and compared each response to the selected photographic depiction in gram weights. Additional calculations and conversions were required to make a fair comparison to *volume* and not *density* for 'fair portion' comparisons. The deliberation, justification, and professional judgment on the researcher's part was applied to each food within the starch-based group. Interpretation and conversion criteria were logged with attention to consistency in data analysis. It is noted here, that the *Rulebook* was not evaluated by others prior to using any of the data. From the preliminary research conducted for this study, no standards were found regarding how to deal with the conversion issues related to volume vs. density in calculating gram weight equivalents. Nelson and Haraldsdóttir (1998, 236) mentioned that "There may be problems when assessing weights of equivalent foods if food densities are markedly different between 'equivalents' (e.g. bran flakes are much more dense than cornflakes)." Apart from that comment, nothing specific elsewhere was found.

In spite of possible limitations in this study, a strength in the design was the standardization of the interview process (Posner and Morgan, 1981), and the fact that one main researcher did all the data collection, interpretation, conversion calculations and comparisons, so consistency and continuity in procedural implementation should be

reflective of the outcomes.

Future studies should aim to detail conversions for portion comparisons with the other food groups, e.g. fruits & vegetables, dairy/meats, etc. In addition, it may be beneficial to validate the format used for this study to further examine the procedures employed for effectiveness and transferability to other methods of portion size estimation. An observation is that previous studies have demonstrated that solid foods are generally estimated with greater accuracy than amorphous foods. The main food group that includes these amorphous foods is the breads, cereals, and starchy vegetables group. Problems related to food specific difficulties in estimation and conversions may be limited primarily to this group.

The *Portion Photos of Popular Foods* book aimed to differentiate between the 3 different types portion size standards promoted in the US for health and education. Current standards are not representative of what is *actually* being consumed (Young and Nestle 2002, 246). Though subjects were receptive to the color portion format of the book and photographic depictions, it is difficult to assume that portion-size estimation improved as no known measure (weighed amount) was used as the referent value for each food. The outcomes of this study concur that without any portion-size training, significant variations in portion estimation will remain.

Conclusions

In concurrence with previous research, (Chambers, Godwin and Vecchio 2000, 896; Nelson, Atkinson and Darbyshire 1994, 649), researchers need to understand

memory structure and assist respondents in remembering food consumed. Though many diet assessment methods have been shown to be adequate indicators of predictable intake, it is still very apparent that there are many limitations with each one. New standards are needed to facilitate portion-size estimation. Similar to individuals' broad variations in learning styles, e.g. concrete, vs. abstract; mathematical vs. visual, etc., several portion aids should be used to better assist in quantification. A model similar to that described by Baxter et al.(1997, 31) for children, needs to be developed for emerging adults to assist in identifying aids most suitable to matching individuals' conceptual strengths and limitations. Granted this would be a more time-consuming approach, however, the emphasis on quality over quantity can often be more representative of that which is being measured.

"Significant health policy decisions are based on nutritional epidemiological evidence obtained from 24-hour recalls. Findings from this study call to question dietary advice based on 24-hour recalls as a sole source of dietary intake data and they advocate for corroborating methods that are food specific: portion photo accompaniment may be essential or inconsequential, depending on the food" (Lohse Knous, 2003).

Hypothesis testing

The hypotheses of this study were examined:

Primary Null Hypothesis: There will be no significant difference between portion sizes reported via a standard 24-hour recall (24R) without a photographic aid to those reported

with the *Portion Photos of Popular Foods* (3PF) photographic aid.

Outcome: The Primary Null Hypothesis was not refuted. The results were unable to show that there was a significant difference in 24R portion sizes compared to 3PF portion sizes.

2nd Null Hypothesis: Differences in gram weight comparisons of 24R portion sizes vs. 3PF portion sizes will not be directional for over-, under-, or exact-reporting.

Outcome: The Secondary Null Hypothesis was not refuted. The results were unable to show that there was a significant difference in reporting direction.

3rd Null Hypothesis: Directional differences between 24R and 3PF portion sizes will not be associated with gender, BMI and demographics.

Outcome: The Tertiary Null Hypothesis was not refuted. The results were unable to show that there was an association between directional reporting differences and gender, BMI and demographics.

Recommendations

Food Specific Recommendations

Aids that will assist in amorphous food estimation need closer examination:

- The results of this study and others (Nelson, Atkinson and Darbyshire 1994, 660) demonstrated significant discrepancies in over- and under-reporting ranges for

spaghetti. In this study, spaghetti was the food with the greatest range of discrepancies and posed most challenging for subjects to estimate. One recommendation is for the development of soft plastic-like 'spaghetti-strings' that can be 'served' and thus matched to the amount consumed. Pasta servings of often 8 times the *standard* USDA portion of "½ cup" is not uncommon, so food-specific measurement aids would help dietitians immensely in portion and energy estimation.

- Similarly, having several varieties of snack chips available where the subject could portion 'the serving consumed' may be another way to more closely determine the actual quantity eaten.
- Having a participant bring a few representative serving items from home (e.g. plate, serving cup, bowl, etc.) and using these as a reference for foods consumed. All people use different-sized kitchen-wear and this may be the first line of error as foods consumed are envisioned on these. If a close representative is not available via aids, portion-sizing may be affected.

Include an additional portion-estimation method to help clarify a portion recall response and also to serve as a 'cross-check'. This is employed during the diet history assessment where a 24-hour recall often serves as the 'cross-check' to what was previously reported. Ideally, observation (considered the 'gold standard') and weighing before serving would allow for an accurate comparison measure prior to the recall, though this is often not possible due to time, cost, and other resource constraints. The

best co-method could depend on whether the subject tends to be a more visual, perceptual or concrete information assimilator.

3PF Specific Recommendations

For future editions of *Portion Photos of Popular Foods*, considerations may include:

- Photograph portions "straight-on" instead of at an angle. Many subjects commented on the difficulty they had estimating portion sizes from specific photos, as there appeared to be considerable angular distortion. This was particularly a problem with 3 plates appearing on a single page. When three depictions were shown on a 'double page', the distortion decreased.
- However, problems with distortion were frequently reported for the pizza slices (Hess, 1997, 92-93), shown on a double page. Respondents had repeated difficulty in estimating pizza intake by selecting from the photos. Though equal gram amounts for thick and thin are shown, the diameters of the individual slices vary considerably, and the stacking make the slices underneath difficult to decipher.
- Another suggestion would be to include standard frozen pizza slices (e.g. Red Baron, Tombstone) as an option rather than all take-out as these tend to be eaten just as frequently, but look considerably different.
- Descriptions of slices as '5 oz' are not useful without the other dimensions. Nasco food models (Nasco, 2002, 19) include: e.g.) Pizza, sausage and

pepperoni, one 5 ½" sector, ⅛ of a 14" dia. 7 ¼ oz. (210g).

- Quantify 'standard' portions in quantities of 5 grams; this would facilitate conversion and assist in standardizing a system which could benefit from updating. Calculating 1 cup of cereal at 30 grams, and 2 cups at 55 grams introduces another range of error, which would not exist with amounts that can be easily multiplied or divided by fractions.
- Another picture that presented with difficulties was the chicken breast (Hess, 66). Respondents felt that the 3 depictions looked identical. This perception could be due to the angle at which they are shown, the surrounding shadows, or the fact that the sizes are very similar.
- Specific foods identified by this study (e.g. spaghetti, tortilla chips, pasta salad), may warrant different photographic representation to better assist in portion estimation; possibly only 1 serving per page and photographed *directly* rather than at an angle.
- Consider a white plate for displaying food; the blue competes for with attention. Extensive research conducted by Nelson et al. (1998, 233) recommends that the background should be unobtrusive and neutral in character; in addition, reference objects (e.g. plate, knife and fork or other cutlery) should be included in every photograph and also provided to subjects as real objects. Nelson et al. (234) adopted the format of eight 6 x 8 cm images on one A4 (20 – 29 cm) page. This

provided the largest amount of useful information in the least amount of space. A one-page example depicts 8 portions of cooked shell macaroni. Despite the smaller-sized pictures, the inclusion of the fork and knife next to each plate gives the photograph perspective. Also the portion distinctions appear recognizable and the white background and plate color do not distract from the presentation.

- Consider including a questionnaire and a User's guide specific to the book for use in a clinical, research or educational setting. Conversion findings from this study could be included to assist future validation studies.
- Most of the 'solid' foods depicted in the book presented with little difficulty; the photos were highly comparable to what the subjects' reported consuming. Apart from the items discussed above, it was primarily the amorphous foods within the starch-based foods that posed significant challenges in portion-estimation.

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Appendix A.

Demographic Survey

Food Record Form

Please complete the following:

Code number: _____

Gender (male or female): _____ **Age** (closest year): _____

Height: _____ (optional) **Weight:** _____ (optional)

Major area of Study: _____

Day & Date of the week recalled for this diet interview:_____

Have you had a college level nutrition class in the past?: _____

Do you have any medical problem(s) that have required you to change your diet? Briefly indicate the problem(s) and change(s) that you made:

_____
_____
_____
_____

Food Record

Food	Description size/form/diameter/ length/width/brand/ med/large	24 Recall Amount	Page Photo Book	Portion Food 1,2,3 A-E	Recall grams	Book grams	Difference +/-
Bread/Cereal							
Vegetables							
Fruit							
Milk/Dairy							
Meat/Poultry Etc.							
Fat/Oil/ Sweets							
Combination Foods							
Beverages							
Foods not shown in photos:							

Appendix B.

IRB Protection of
Human Subjects

Consent form

Consent form
for Videotaping

RECEIVED

MAR 2 0 1998

GRADUATE COLLEGE

(ATTACH PROTECTION OF HUMAN SUBJECTS FORM AND OTHER PERTINENT INFORMATION)

The Graduate College
University of Wisconsin-Stout

PRELIMINARY STATEMENT AND APPOINTMENT OF RESEARCH ADVISER

Student Kim Louise Edens Social Security [redacted]
First Middle Last

Address 816-21st ST. N. Menomonie, WI 54751
Street City/State Zip

Date 02-23-1998 Degree Major Food Science and Nutrition

Tentative Research Area or Title Dietary Intake Analysis

Statement of Problem to be Investigated:
(Underline one: Thesis-Plan A or Problem-Plan B)

The purpose of this study is to determine the difference between reported portion sizes with or without the use of the "Portion Photos of Popular Foods" book so to evaluate the usefulness of photographic visual cues.

Qualifications of Student for Study: Registered Dietitian (Oct, 1997).
- Completion of ADA accredited 9-month internship at the University of California - San Francisco Medical Center (6/96-7/97).
- Nutrition Consultant for the Preventative Medicine Research Institute (PMRI) headed by Dr. Dean Ornish. (author of "Reversing Heart Disease") Primary responsibilities included analyzing food intake records to determine

Tentative Design of the Research: program adherance of Prostate Cancer Study participants

The research will involve a cohort study using the one-group pretest-posttest design. (Campbell, D.T., Stanley, UC "Experimental and Quasi-experimental designs for research") As stated the purpose of the study is to determine the effect of photographic visual cues on dietary recall to determine the validity of the "Portion Photos of Popular Foods" book. The PRE-TEST will be the initial 24-hour diet recall before the use of visual cues. The POST-TEST consists of a secondary recall clarification using photographic visual cues.

Sent
3-31-98

Proposed Use of Findings:

The goal of this study is to establish new standards for improving the accuracy of dietary analysis. It is imperative for Registered Dietitians to have resources available to clarify actual dietary intake verses estimations, as it strongly impacts nutrition therapy recommendations. By validating the "Portion Photos" book, the applications for its use will be broadened within the professional setting

Is information being collected from or about people in this study? Yes ✓ No

In accordance with my research advisor and my graduate program, my research report will be prepared according to the specifications of the following style manual:

I am working with my graduate research adviser and subcommittee for the protection of human subjects in graduate study research. I am submitting this preliminary research plan and understand that legislation requires that protection of human subjects is assured and that my plan for protection is approved before I collect any data.

Student's Signature [signature] Date 02-23-98

- -

1. Acceptance by Research Adviser:
   I agree to serve as the Research Adviser and recommend the research plan as delineated.

[signature] (Research Adviser's Signature) 3-5-98 (Date)

2. Approval by Graduate Program Director:

[signature] (Program Director's Signature) 3/4/98 (Date)

3. Assignment of Research Adviser:
   The above named graduate faculty member is recommended as Research Adviser.

[signature] (Research Adviser's Department Chair/Supervisor's Signature) 3-19-98 (Date)

When each signature above is affixed, bring to the Graduate College Office where it will be forwarded to the Chair of the Committee on Protection of Human Subjects in Graduate Student Research. **Gathering of data should not begin until approval from the Committee on the Protection of Human Subjects in Graduate Student Research has been received.**

FOR OFFICE USE ONLY
Protection of Human Subjects in Graduate Student Research Action:

Approval Signature [signature] (Committee Chair) Date 3/25/98

Distribution of copies:
(1) Graduate College (2) Dept Chair/Supervisor (3) Research Adviser
(4) Program Director (5) Student

104-1001A/B
Rev. 8/96

Diet Interview Research Project

Kim Edens, RD, a graduate student in Food Science and Nutrition, and Barbara Knous, PhD, RD, CD are conducting a research project titled, diet interview
Research project. We would appreciate your participation in the study.

The purpose of this study is to investigate different methods of measuring dietary intake.

It is not anticipated that this study will present any medical or social risk to you. The information gathered will be kept strictly confidential and any reports of the findings of this research will not contain your name or any other identifying information.

Your participation in this project is completely voluntary. If at any time you wish to stop participating in this research, you may do so without coercion or prejudice. Just inform the researcher.

Once the study is completed, the analyzed findings would be available for your information. In the meantime, if you have questions, please contact: Barbara Knous, PhD, RD, CD, Food and Nutrition Department, School of Human Services, University of Wisconsin-Stout, Menomonie, WI 54751, phone (715) 232-1994.

Questions or concerns about participation in the research or subsequent complaints should be addressed first to the researcher or research advisor and second, to Dr. Ted Knous, Chair of the UW-Stout Institutional Review Board for the Protection of Human Subjects in Research, 410 BH, UW-Stout, Menomonie, WI 54751, phone (715) 232-1126.

Consent Form

I understand that my participation in this study is strictly voluntary and I may discontinue my participation at any time without prejudice.

I understand that the purpose of this study is to investigate different methods of measuring dietary intake.

I further understand that any information about me that is collected during this study will be held in the strictest confidence and will not be part of my permanent record. I understand that in order for this research to be effective and valuable, some demographic information will need to be collected. I also understand that the strictest confidentiality will be maintained throughout this study and that only the researchers will have access to information that I supply on surveys or in interviews. I understand that at the conclusion of this study all records will be destroyed. I am aware that I have not and am not waiving any legal or human rights by agreeing to this participation.
By signing below, I verify that I am 18 years of age or older, in good mental and physical condition, and that I agree to and understand the conditions listed above.

Signature: _____ Date: _____

Consent Form—Videotaping

I, _____, consent to participate in a videotaped session of the diet interview project for purposes of evaluating the preliminary results of this project.

I understand that this videotaping will be strictly confidential and will only be used by the researchers to evaluate the interviewing process.

Signature: _____ Date: _____

Consent Form—Videotaping

I, _____, consent to participate in a videotaped session of the diet interview project for purposes of evaluating the preliminary results of this project.

I understand that this videotaping will be strictly confidential and will only be used by the researchers to evaluate the interviewing process.

Signature: _____ Date: _____

Consent Form—Videotaping

I, _____, consent to participate in a videotaped session of the diet interview project for purposes of evaluating the preliminary results of this project.

I understand that this videotaping will be strictly confidential and will only be used by the researchers to evaluate the interviewing process.

Signature: _____ Date: _____

Appendix C.

Subject Recruitment ‘Sign-Up’ Sheet Example

OPPORTUNITY TO BE IN RESEARCH PROJECT

Spend approximately 20 minutes in a diet interview and receive 5 extra credit points. The interview will be conducted by Kim Edens, Registered Dietitian and graduate student and will be held in the Home Economics Building, Room 203.
Please feel free to contact me if you have any questions or have alternative times when you want to meet, at: 235-1527 or via email: edensk@uwstout. edu

Please indicate which time you would like to participate:

Date/Time	Name	Phone	E-mail
Thursday, April 16			
08:00 AM			
08:20 AM			
08:40 AM			
09:00 AM			
09:20 AM			
09:40 AM			
10:00 AM			
10:20 AM			
10:40 PM			
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03:40 PM			
04:00 PM			
04:20 PM			
04:40 PM			
05:00 PM			
Friday, April 17			
08:00 AM			
08:20 AM			
08:40 AM			
09:00 AM			
09:20 AM			
09:40 AM			

Appendix D.

Abbreviation Legend

Abbreviation Legend:

University of Wisconsin-Stout majors:

AD= Apparel Design
AM= Applied Math
A = Art
AE= Art Education
B = Business
BA= Business Administration
BC= Building Construction
C = Construction
E= Education
EC= Electric & Computer
ECE= Early Childhood Education
FCE= Family & Consumer Education
FST/FMD= Food Systems & Technology; Food Merchandising & Distribution
GD= Graphic Design
GCM= Graphic Communications Management
H= History
HDFS= Human Development & Family Studies
HT= Hospitality & Tourism
ID= Industrial Design
ITFM= Industrial Technology-Facilities Management
ITMM= Industrial Technology--Manufacturing Management
ITPD= Industrial Technology--Product Development
ITT= Industrial Technology-Telecommunications
ME= Manufacturing Engineering
Pa= Packaging
Ps = Psychology
RMM= Retail Merchandising & Management
SA= Studio Art
SE= Special Education
T= Telecommunications
U= Undecided
VTAE= Vocational, Technical and Adult Education
VR= Vocational Rehabilitation

Nutrition Courses:

IN= Introduction to Nutrition
NH= Nutrition for Hospitality
NHL= Nutrition for Healthy Living
NYC= Nutrition for the Young Child

Semester:

SP= Spring semester—1998
SU= Summer session---1998

Appendix E.

List of Starch-Based Foods

LIST OF STARCH-BASED FOODS

FOOD	ABBREV.	n =	OVER	UNDER	EXACT
BAGEL	BG	10	5	2	3
BISCUIT	BS	1	1	0	0
BREAD, FR.OR ITA.	BD	3	1	0	2
BREAD STUFFING	BDST	2	1	1	0
CEREAL, COOKED	CCK	1	1	0	0
CEREAL, GRANOLA	CGRA	2	1	0	1
CEREAL, READY-TO-EAT	C	29	5	16	8
COOKIES	CK	5	0	4	1
CRACKERS	CX	6	3	1	2
CROISSANT	CR	2	1	0	1
ENGLISH MUFFIN	EN	3	3	0	0
MUFFIN	MF	2	1	0	1
PANCAKES	PC	2	0	2	0
PASTA SALAD	PS	8	5	3	0
POPCORN	PP	3	2	1	0
RICE	RC	9	3	2	4
SPAGHETTI	SG	17	13	3	1
TORTILLA CHIPS	TC	13	5	7	1
CORN	CN	4	4	0	0
POTATO, BAKED	PBK	7	2	2	3
POTATO CHIPS	PH	4	3	0	1
POTATO, FRENCH FRIED	PFF	8	7	1	0
POTATO, MASHED	PMA	1	0	1	0
POTATO, SCALLOPED	PSC	2	2	0	0
HAMBURGER BUN	HMB	3	2	1	0
HOTDOG BUN	HTB	6	0	0	6
LASAGNA	LSG	1	0	1	0
MACARONI AND CHEESE	MC	4	1	1	2
PIZZA	PZ	16	2	4	10
SUBMARINE SANDWICH	SS	7	1	1	5

Appendix F.

Rulebook

RULEBOOK INDEX: Breads/Cereals/Starchy Vegetables

HOW GRAM WEIGHTS WERE DETERMINED:

•Portion sizes reported during the 24-hour recall **(24R)** were converted to standard reference gram weights in the *Portion Photos of Popular Foods* **(3PF)** (Hess 1997) to compare *volume* rather than *density* for fair portion-size comparison. Also, the order of food items listed correlates with the 3PF appendix.

•Each food item is listed followed by values from Nutritionist IV nutritional analysis software program and standard references from the USDA nutrient database for comparison purposes only; *the Portion Photos of Popular Foods* (3PF) book was used as the primary reference unless noted otherwise.

•Gram weights for the three portions pictured and as listed in TABLE ONE (FOOD PORTIONS IN PHOTOGRAPHS) (pp. 122-130), are cited under each headed by **3PF as STD**

• Underneath each divisional line is the sequence as follows: the student ID number, the portion described by that subject, (an optional USDA or Nutritionist IV standard portion comparison), and the calculations used to determine the gram amount for that report based on the 3PF standard gram referent values.

•The pictures of some foods, including bagels (1), biscuits (2), French bread (3), croissant (14), english muffins (15), muffin (16), corn (32), and baked potato (36) were ruler-measured by the researcher from the book for comparison purposes. Those measurements are listed under each food because it was required for size verification and for selecting the closest match to that reported by the subject.

•Subjects described these foods by demonstration with their hands. Those dimensions were measured with a ruler; the 24R-size reported was matched to the closest dimensional size representation in the 3PF book (as noted in the previous comment), and the corresponding gram weight amount recorded.

•For numerous foods where a fraction of a serving needed to be calculated, (e.g., ¼ C reported , and all that was listed in the 3PF was 1C), the Cup gram amount was divided in '4s' to get the ¼ C gram size. However, it was noted that gram values differed for the same food when comparing e.g.) 1C, 1- ½ C, and 2C gram weights of the same food in 3PF; the manner in which this was resolved was by calculating the average of the 3 measurements cited in the book (See: (4), Bread Stuffing; (8), Cereal, cooked; (10), Ready-to-eat Cereal; (26), Tortilla chips; (92), Pizza; (96), Submarine Sandwich))

•Unique conversion dilemmas presented with the amorphous foods of crackers (13), tortilla chips (26-27), French fries (38). With these and every other food in the RULEBOOK, the calculations and supporting information are included to support the data for each food category.

•A potential error was discovered with the hotdog bun (89). In Table 1, the gram amounts are listed for both the hotdog sandwich (hotdog & bun combined) and the hotdog only, so by subtracting the hotdog, the bun gram amount should be obtained. However, the 'small'-size bun equals 44g, while the 'medium'-size is 42g.

---

1. BAGEL:
NutrIV#4910-bagel-plain-enriched-3-½"dia=71g
USDA#18001(5 sizes cited):
1 bagel(3"dia)= 57.0g
1 bagel(3-½"dia)= 71.0g
1 bagel(4"dia)= 89.0g
1 bagel, mini(2-½"dia)=26.0g
1 bagel(4-½"dia)= 110g

3PF as STD:
1 medium=83g; (measured from book: 1"x3-¾"dia)
1 large=97g; (measured from book: 1-½"x4-¾"dia)
½ medium=38g; (measured from book: ½"x4")
*****note=closest 3PF match chosen based on reported height AND diameter*****

416-1300-07: "1 ½"X4"dia bagel"; 1 bagel(USDA-4"dia): 89g; 3PF=1 medium=83g
416-1640-14: "Lammer's(grocery store)bakery bagel—4"dia; 1 bagel(USDA-4"dia): 89g; 3PF=1 medium=83g
417-1020-03: "student center—bagel(marble)(3½"dia)"; 1 bagel(USDA-3½"dia): 71g; 3PF=1 medium=83g
417-1120-06: "Brooklyn Bro's bagel(2"X4½"dia)"; 1 bagel(USDA-4½"dia)=110g; 3PF=1 large=97g
625-0800-01: "whole wheat bagel(1¼"x4"dia)--½"; 1 bagel(USDA-4"dia): 89g; ½ =44.5g(45g); 3PF as STD: 1 medium=83g / 2= 41.5g (42g)
701-1440-06: "bagel(1-½"x4"dia)"; 1 bagel(USDA-4"dia)=89g; 3PF=1 medium=83g
701-1520-08: "New York Internat'l bagel(2-¼"x4"dia)=1 bagel(USDA-4"dia)=89g; 3PF=1 large=97g

701-1600-09: "bagel(1"x3-⅝"dia)"; 3PF=1 medium=83g
701-1620-10: "bagel(2-½"x4")"; 3PF=1 large=97g
723-1320-03: "Lenders cinn.bagel—1"; per manufacturer—3"dia—81g; 3PF=1 medium bagel=83g

2. BISCUIT:
NutrIV#8540—biscuit-plain: 35g
3PF as STD:
1 medium=54g; dimensions measured: 1-¾"x 3-¼"
1 large=96g; dimensions measured: 2-¼" x 3-⅝"
1 small=28g; dimensions measured: 1-½" x 2–¾"

416-1400-10: "2"X2" shortcake"; 3PF=28g

3. BREAD, FRENCH OR ITALIAN:
USDA#18029--Bread, french or vienna:1 med. slice (4-¾"x4"x½")= 25g/slice
3PF as STD:
3-½"slice=52g; 6-½"slice=91g; 2"slice=26g
Ave. *per inch* gram amt=52/3.5=14.9; 91/6.5=14; 26/2=13; 14.9+14+13=42/3=14g ave. per inch

416-0900-01: "2 slices of Texas toast"; medium size selected as 3PF STD= 52g/slice X2=104g
416-1540-12: "'Tombstone(?correct brand) french bread pizza—(4"X8")"; (comparison) per Rainbow grocery store check, only french bread pizza found: Stouffers (pepperoni)=2/pkg; 1 svg=1 pizza=159g; 3PF=8"x14g/inch=112g
417-1000-02: "Garlic (parmesan) cheese bread(1"X4"X4")—1"; 3PF=52g

4. BREAD STUFFING:
NutrIV#2845--Stuffing-Mix-Chicken-STOVE TOP; 2C=112g
3PF as STD:
1/3 C packed; ½ C loosely packed=60g (÷2=30g/¼C)
2/3 C packed; ¾ C loosely packed=100 (÷3=33.3g/¼C) x2=66.6g/½C (67g)
1–¼ C packed; 1-½C, loosely packed=200g; (÷6=33.3g/¼C) x8=(2C)=267g

416-0920-02: "Stovetop Stuffing: 7"/ ¼ of box—2C"; 3PF=267g
721-1000-03: "wild rice Stove Top stuffing: ½C"; 3PF=67g

5. BROWNIE: NONE

6-7. CAKE WITH FROSTING: NONE

8. CEREAL, COOKED, OATMEAL, GRITS, POLENTA, ETC:
NutrIV#366-oatmeal-cooked-1C=235g
3PF as STD:
1 ½ C=339g; 1C=230g; ½ C=111g
(comparison per ¼ C: 56.5, 57.5, 55.5; ttl=169.5g ÷3=average of 56.5g ÷ ¼C)

417-1140-07: "Quaker oatmeal(instant pkg)—3/4C"; 3PF=3x56.5=169.5(170g)

9. CEREAL, GRANOLA, GRAPE-NUTS OR FRUIT/GRAIN COMBINATIONS:
3PF as STD:
¼C=26g; ½C=55g; 1-½C=165g (1C=110g)

625-1400-09: "Raisin bran: ½C"; 3PF=55g
721-0840-02: "Just Right cereal: 2C"; 3PF=220g

10. CEREAL, READY-TO-EAT:
3PF Book was used as the STD for reported cereal amounts consumed.
Volume used to quantify rather than density as to not bias comparison amounts.
Bold=3PF; Standard font=amount calculated based on book STD.
(NOTE:per all 3 cereal gram amounts cited in Table One: average= 6.5g/¼C)**
[20g÷3=*6.66*; 30g÷5=*6*; 55g÷8=*6.88*= *6.66* + *6* + *6.88* ÷ 3=6.5g/¼C]
3PF as STD

¾C=20g;	¼C=6.5g;	½C=13g;	1C=25g
1-¼C=30g	1-½C=39g	(¼C=6.5g x 6=39g)	
2C=55g	2-½C=65g	(¼C=6.5g x 10=65g)	

416-1220-05: "Kellogg's Corn Pops: (5"dia)-1-¼C"; 3PF=30g
416-1340-08: "Raisin Bran: 1C"; 3PF=25g
416-1640-14: "Coco-roos: 1-½C; 3PF=39g
417-1000-02: "Honey-Nut Cheerios: 1C"; 3PF=25g
417-1120-06: "Quaker Apple Crisp cereal: 3C"; 3PF=75
417-1140-07: "Cinnamon Life cereal: 2-½C"; 3PF=25g/C X2-½=63g
417-1540-12: "Lucky Charms cereal: 1C X2"; 3PF=2C=55g
423-0900-01: "Quaker Cocoa Puffs: 2C"; 3PF=2C=55g
423-1320-05: "Cheerios: 1¼C"; 3PF=30g
423-1400-06: "Quaker safari marshmellow cereal(like Lucky Charms): 3 servings: 1C; 1½C, 1½C; 3PF=25g+39g+39g=103g
423-1500-08: "Frosted Flakes: 2½C"; 3PF=10x6.5g=65g

423-1540-09: “Honey-nut Cheerios: 1C”; 3PF=25g
*424-1140-04: “Grapenuts: ½C”; 3PF=13g (noted that #9 (cereal, granola, grape-nuts or fruit/grain combinations) should have been used for comparison purposes during the interview)
*424-1140-04: “Frosted Wheaties: ½C”; Book as STD: 13g (*combined=26g)
424-1320-05: “Lucky Charms: 1C”; 3PF=25g
625-0800-01: “Special K-(snack pack)-1 oz svg”; per manufacturer: svg size=1C=31gm; Converted to 3PF as STD: 1C=25g
625-0840-03: “Frosted Flakes: 2C”; 3PF=55g
701-1200-04: “Frosted Flakes: 2C”; 3PF=55g
701-1520-08: “Chex Mix: 2C”; Book as STD: 55g
701-1600-09: “Cornflakes: 1C”; 3PF=25g
702-1000-01: “Lucky Charms: 3C”; 3PF=75g
*702-1100-02: “Cinnamon Toast Crunch: 2C”; 3PF=55g
*702-1100-02: “Shredded Wheat-strawberry: 2-½C”; 3PF=65g (*combined=120g)
702-1400-05: “Super Golden Crisp: 2C”; 3PF=55g
721-1000-03: “Cheerios: 1-½C”; 3PF=39g
721-1200-04: “Kellogg’s raisin bran: 2-½C”; 3PF=65g
721-1320-07: “Cocoroos: 2-½C”; 3PF=65g
722-0800-01: “Applejacks: 1oz(indiv.box)”; 3PF=1C=25g
722-1300-02: “Wheaties: 1C”; 3PF=1C=25g
723-1300-02: “Honeycomb: 2C”; 3PF=2C=55g
724-1400-01: “Captain Crunch: 2C”; 3PF=55g

11. COOKIES:
USDA#18178—1 large(3”dia)=18g
3PF as STD:

3 small;	2”=32	÷3=(10.7(11g)each);
1 large;	5”=95g;	
3 medium;	2-½”=62g	÷3=20.7(21g) each

416-1700-15: “oatmeal cookies w/icing—(¼”X3”dia)—3 items”; USDA#18178—1 large(3”dia)=18g; X3 items=54g; 3PF=1 medium=21g x3=63g
423-1220-03: “oreos—5”; NutrIV#14152—cookie-chocolate sandwich-oreo-nabisco= 5 items=55g; 3PF=5 small=5x11g/item=55g
625-1200-06: “peanut butter cookie(½“x4”dia)”; NutrIV#15801---cookie-peanut butter-big-grandma’s: 1 item=39g; 3PF=(closest to lg)=95g
625-1600-11: “CUB foods bakery choc.chip cookie(⅜”x3¼dia”)”: 3 cookies; USDA#18165-chocolate chip cookie-(2¼”dia)=16g; 3PF=(between med & lg—21+95=116/2=58g x 3 cookies=174g
722-0800-01: “raisin-oatmeal cookie(¼”x3”dia): 1”; 3PF=1 medium=21g

12. CORNBREAD: NONE

13. CRACKERS:
NutrIV#18690-cracker-triscuits: 1 item: 4.5g/item
3PF as STD:
***(round=ave. 3.4g/item; thin=ave. 2.5g/item)
portion 1: 6 round/8 thins: 20g;
portion 2: 12 round/16 thins: 40g;
portion 3: 8 round/11 thins: 28/29g;
NOTE: Cracker category generally reported as a specific number consumed; Measurements cited as "a cup", standardized to 1.5oz serving=42g (28g/oz x 1.5 oz.=42g); Aircrisp cheeze-its (1C) counted as 1oz serving (larger in size)

416-1400-09: "Triscuit(triangles)-8"; 8 x 3.4g/item= 28g
417-1340-10: "Aircrisp Cheeze-its: 1C"; ~1 serving=28g;
3PF=11thins/28g=11x2.5g/thin=27.5(28g)
423-1220-03: "Triscuits—20"; 20 x 3.4g/round= 68g
423-1240-04: "Triscuits—10"; 10 x 3.4g/round= 34g
721-0840-02: "Wheatables crackers—1C"; 1C= 42g
722-0800-01: "Wheat thins: 17"; 17x2.5g/thin=42.5(43g)

14. CROISSANT:
USDA----[(4 sizes cited: mini (28.35g); small(42g); medium(57g); large(67g)]
NutrIV#9073-croissant-butter=57g (only 1 size in database)
3PF as STD: (dimensions measured from book photos):
small: 27g(2-½"x3-½") ; medium: 54g(3-¼"x 3-¾") ; large: 81g(4"x5")

424-1140-04: "croissant(1½"x4½"x5")"; 3PF large=81g
625-1200-06: "croissant---(2"x5")"; 3PF large=81g

15. ENGLISH MUFFIN:
NutrIV#1382—muffin-english-plain-tstd: 1 item=52g
3PF as STD:
1 large (measured 1"x3-⅜x3-¾")=92g
½ medium (measured ⅜"x2-¼"x3-⅝")=25g
1 medium (measured ¾"x3x3-¼")=52g

417-1340-10: “english muffin(1-½”X4”dia)”;1 large=92g
721-0800-01: “english muffin(1-½”x4”dia)”; 1 large=92g
722-1320-03: “english muffin(Pawn-café; ½”H for ea. ½--4”dia--1”; 1 large=92g

16. MUFFIN, PLAIN OR FRUITED, OR CUPCAKE:
USDA STD#18274
1 large muffin(3¼”diaX2¾”)=71g
3PF as STD:
1 small (measured 1-¼”x2¼”)=38g
1 medium (measured 1-½”x2-½”) =60g
1 large (measured 2”x3-⅜”)=150g

416-1340-08: “3”X3” blueberry muffin: 1”; 3PF=150g
701-1120-02: “choc.muffin(1-½”x3-¼”)”: 1; 3PF=150g

17. PANCAKES:
USDA#18293-pancakes-4”dia=38g
3PF as STD:
2 – 4-inch diameter: 91g (46g each)
3 – 6-inch diameter: 300g (100g each)
1 – 4-inch diameter: 47g

417-0940-01: “blueberry pancake(4”dia)—2”; 91g
625-1520-10: “pancakes(4”x4”)--4”; 2x(2--4”dia)91=182g

18. PASTA SALAD, GRAIN SALAD, OR POTATO SALAD:
NutrIV#25273-pasta salad=4oz=113.4g; (plus NutrIV#160-sld-tuna-celery-mayo-pickle-egg=1oz=28.35g=142g)
3PF as STD:
1-½C=215g; ½C=75g; 1C=143g

625-1320-08: “tuna pasta salad: 1C”; 3PF=1C=143g
625-1400-09: “potato salad: ¼C”; 3PF= ½C=75g; ¼C=38g
629-0840-01: “pasta salad: 1-½C”; 3PF= 1½C=215g
630-1100-02: “Pasta accents: ½C”; 3PF= ½C=75g
701-1500-07: “macaroni & cheese: 1-½C”; 3PF=1-½ C=215g
701-1640-11: “Lipton noodle mix(chicken/broccoli)--(~½”x9”): all”; per manufacturer: svg sz=2/3C(=1C prepared); svgs/cont.=2; 2C=287g
721-1220-05: “macaroni & cheese-spirals: 1 box”; (4C prepared/box)—4x 143g/C=572g

723-1300-02: “macaroni & cheese: 1C”; 3PF=1C=143g

19. PIE, APPLE OR OTHER: NONE

20-21. POPCORN:

(Compare to NutrIV#3439-popcorn-butter flavor-Pop Secret=1C=7.5g
NutrIV#476—popcorn-popped-plain: 1C=8g)
**(NOTE: Microwave bags of popcorn---(Rainbow)grocery store check: per manufacturer(Orville Redenbacher ‘movie theater’)=11.5C popped yield & (Orville Redenbacher ‘ultimate butter’)=12.5C popped yield (~ave-12C/bag)

3PF as STD: (1 giant bag=20C=230g; /20C=**11.5g/**

417-1040-04: “popcorn(handful): ½C”; 3PF= 11.5g/C/2=5.75g (6)
423-1500-08: “microwaved popcorn: ‘½ bag’: ~3C”; =½ bag=ave~6C popped. 3PF=6C x 11.5g/C=69g
701-1120-02: “Orville Redenbacher Light(microwave): 1 bag”; per manufacturer~12C/bag; 3PF=12C x 11.5g/C=138g

22. RICE:

NutrIV#484—rice-white-long grain-enr-cooked: 1C=158g
NutrIV#11423—rice medley-frzn-green giant: 1C=227g

3PF as STD: ½C=72; 1C=140g; 1/3C=53g; 1-½C=210g; 2C=280g
***multiples of 3PF were made based on the 1C ‘average’ of 140g

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416-1400-09: “1C”; 1C=140g
417-1000-02: “rice medley—1C”; 1C=140g
424-1320-05: “rice: 1½C”; 1-½C=210g
625-0840-03: “rice: 1C”; 1C=140g
625-1600-11: “fried rice/pint carton: ½ carton: 1C”; 1C=140g
701-1440-06: “Lipton rice & sauce w/broccoli: 3C”; 3PF=3x140g=420g
706-1100-01: “Uncle Ben’s chicken & wild rice: 1C”; 3PF=1C=140g
723-1320-03: “rice: 1-½C”; 3PF=1-½C=210g
804-1030-01: “Uncle Ben’s-5min rice: ½ bag”; boil-in-bag: 2C/bag; 1C=140g

23. ROLLS: NONE

24. SPAGHETTI, PASTA OR NOODLES:

USDA#20113—chinese noodles: 1C=45g
NutrIV#2881—pasta-spaghetti-cooked; 1C=140g
Per manufacturer (Creamette): 1oz dry=28.375g= ½C cooked (70g); 1C=140g

3PF as STD: ½C=72g; 1C=140g; 2C=270g; (1C=140g used as STD)

416-1040-04: "(8"x8"x1")-Pasta-Spaghetti: 1-½ C"; 1-½C=210g
416-1400-09: "¾C chinese noodles"; ¾C=105g
416-1700-15: "spaghetti: 9"diaX1"H—5C"; 5C=700g
417-1140-07: "rotini noodles(2½C)"; 1C=140g X 2-½C =350g
417-1300-09: "spaghetti (Creamette): 3oz(6oz bag/had ½)"; 3 oz=210g
417-1540-12: "spaghetti: 16oz pkg-had ½(8oz)"; 8oz dry=4C ckd; 4x140g=560g
423-0940-02: "spaghetti: 8oz dry/2"X9"dia"; 1oz dry=½C ckd(70g); 8oz=560g
*423-1640-10: "Creamette wide noodles: 2C"; 2C=280g
*423-1640-10: "Ramen noodles(1 pkg): 2C"; 2C=280g (*combined=560g)
424-1320-05: "spaghetti(2½"x4"dia): 2C"; 2C=280g
625-0800-01: "angelhair pasta—prepared ½ of 16oz pkg/ made 4svgs: had 2oz dry"; 2oz dry=1C cooked=140g
625-1300-07: "egg noodles: 2C"; 2C=280g
625-1400-09: "spaghetti: 1C"; 1C=140g
630-1100-02: "angelhair pasta: ¼C"; 1C=140g— ¼C=35g
701-1200-04: "spaghetti: 6C"; 1C=140g; 6C=840g
721-0840-02: "spaghetti: 2C"; Book STD of 1C=140g used to calc. 2C=280g (portion 1 @ 2C modified from 270 to 280g/2C)
721-1200-04: "egg noodles: 3C"; Book as STD=3C @ 140g/C=420g
724-1400-01: "macaroni & cheese(¼ of box): 1-½C"; 1-½C=210g

25. SWEET ROLL OR DANISH: NONE

26-27: TORTILLA CHIPS OR CORN CHIPS:
Note:
●when 2 estimations were reported—both the size and the number was calculated with the average taken of the two.
●Per www.eatright.org ; (portion sizes) "1 handful"=~1 ounce; (~13 chips)
Per manufacturer: Tostitos round 100% white corn chips: 1oz(28g/13chips) =2.15g/chip (chip pictured in the 3PF book)---2.15g/chip used as standard
NutrIV#12240—tortilla chips-orig.-Doritos-Frito Lay: 1 serving=28g
Per manufacturer: nacho cheese Doritos—1oz (28g/11chips) =2.54g/chip
NutrIV#15783—tortilla chip-baked-tostitos: 2.15g per chip
Per manufacturer: Baked Tostitos: 1oz (28g/20chips) =1.4g/chip
Tostitos (bite size): 1oz (28g/24chips) =1.17g/chip

Tostitos restaurant style: 1oz (28g/6 chips) =4.7g/chip

3PF as STD:	Compared to #37-Potato Chips:
About 2oz of chips=54g; (~2C)	54g=~3C **→(÷3=18g/C)**
1 small bag chips(1oz)=28g; (~1C) (1-½oz=41g)	28g=~1-½C
1 large portion chips, about 3oz=85g (~3C)	85g=~5C

416-1220-05: "Doritos (2 handfuls)-20 chips"; 2 handfuls=2x 13 chips/handful=26x2.15g/chip=56g; 20x2.15g/chip=50g 56g+50g=106g/2=(ave.53g)
416-1240-06: "Baked Tostitos—10 chips"; 10x2.15g/chip=21.5g; compare to: 3PF=10chips/13chips(1oz)=0.769x28g=21.5(22g)
416-1440-10: "Tostitos—2 handfuls--14 chips"; 2 handfuls=13 chips/handfulx2=26x2.15g/chip=56g; 14 chipsx2.15g/chip=30.1g 56g+30g=86g/2=(ave.43g)
416-1500-11: "Baked Tostitos chips(bite-sized): 15"; 15x2.15g/chip=32.3(32g)
PRETZELS***compared to 3PF as STD: 1oz chips=28g; ~1C, ∴2C=54g***
423-1540-09: "mustard pretzels: ½C"; NutrIV#5096—pretzel: ½ C=23g; converted to 3PF as STD=1C=28g; ½ C=14g
625-0840-03: "pretzels: 2C"; NutrIV#5096—pretzel: 2C=92g; converted to 3PF as STD=(2C)=54g
625-1520-10: "Sunchips: "handful": 20-25(23ave);~2C"; handful=13chipsx2.15g/chip=28g; 23x2.15g/chip=49.5g(50g); 2c=56g(28g=1Cx2=56g); average=28+50+56=134÷3=45g
*701-1500-07: "Cheetos: 2C"; 28g/C x2=2C=54g--(not used-unequal represent.)
*701-1500-07: "Pringles: 32 chips"; 32x2.15g=68.8g (69g)---(closer rep. to 3PF)
702-1120-03: "pretzels: 20"; 20x2.15/chip=43g
702-1140-04: "Frito-Lay-baked-tortilla chips: handful"; 'handful'=13 chips=28g
721-1000-03: "nacho cheese Bugles: 2-½C"; 18g/Cx 2.5=45g
*721-1340-08: "Tostitos chips—'even with bowl—5"diax2"deep"; ~2oz=54g
*721-1340-08: "Doritos: 'couple handfuls…=equal to indiv.bag;"; indiv.bag=28g---(not used—STD single serving bag)
804-1030-01: "Doritos: 20 (chips)"; 20x2.15g/chip=43g

28. TORTILLAS: NONE

32-33. CORN:
NutrIV#614—corn-frozen-boiled-drained-kernels; 1C=164g

3PF as STD:		
7oz cob: 200g;	½C+2T kernels=90g;	cob measured=(1-½"x6")
8.1oz cob: 250g;	1C kernels=145g;	cob measured=(2"x6-½")
5oz cob: 140g;	½C kernels=75g;	cob measured=(1-⅜"x4-⅜")

423-1500-08: “whole corn: ⅝C & ¾C”; ⅝(145g)=91g; ¾(145g)=109g;
91g+109g=200g
629-0840-01: “sweet corn-3”x7”: 2 cobs”; 3PF as STD: 500g
701-1520-08: “corn: 1C”; 3PF as STD: 145g
722-1340-04: “corn of the cob—(1-½”x6”): 1”; 3PF as STD: 200g

36. POTATO, BAKED, OR BAKED SWEET POTATO:
USDA(no # cited) STD sizes for: Potatoes, baked, flesh and skin, without salt:
1 large (3” to 4-¼”dia)= 298.9g
1 medium (2-¼” to 3-¼”dia)=172.5g
1 small (1-¾” to 2-½” dia)=137.7g
3PF as STD:
Portion 1: small/medium: 140g; (measured:~2”dia x 3-⅝”)
Portion 2: large: 320g; (measured:~2-¼”dia x 5-¼”)
Portion 3: very small: 90g (measured:~1-¾”dia x 3”)
***NOTE: For dimensions cited between 3PF medium and large, the average was used---
--(med)140g+(lg)320g=460g÷2=**230g**

416-1040-04: “baked potato(2½”X4¼”)”: 1; 1 USDA medium=172.5g;
3PF=med/lg.ave=230g
417-1100-05: “baked potato(2½”X4¼”)”: 1; 1 USDA medium=172.5g;
3PF=med/lg.ave=230g
423-1500-08: “potatoes(2”x4”): 3”; 1 USDA small=137.7g; 3x137.7g=413g;
3PF=(med)140g x 3=420g
630-1120-03: “baked potato(2½”x4½”): ½”;1 USDA medium=172.5g; ½=86.3g;
3PF=med/lg.ave=230g=½ =115g
701-1120-02: “potatoes(2”x3”): 2 ”; 1 USDA small=137.7g: 2x137.7g=275.4g;
3PF=90g x2=180g
721-0800-01: “potato; baked(2-½ x4-¾”): 1”; 3PF=med/lg.ave=230g
722-1300-02: “steamed potato—(2-¼”x3”): 1”; 3PF=1 medium=140g

36. POTATO CHIPS:
Per manufacturer: Lay’s classic potato chips: 1oz(28g/20chips)
Wavy Lays: 1oz(28g/11chips)
3PF as STD:
1 small bag; about 1-½C=28g;
1 large bowl; about 5C=85g;
1 medium bowl; about 3C=54g (÷3=18g/C)--→1C=18g

417-1220-08: “potato chips: 6”; Reference used--NutrIV#15774-potato chip-original-Lay’s: 1 piece=1.55g x6=9g
*625-1100-04: “sour cream & onion potato chips: 1 indiv-size bag(~1oz)”; 3PF=1 small bag=1oz=28g—(not used---STD single serving bag)
*625-1100-04: “onion & garlic potato chips: had ~¼ of 16oz bag (~5oz)”; 1oz=28g x 5oz=140g
721-1220-05: “rippled potato chips: 3C”; 3C=54g
721-1240-06: “Ruffles sour cream & cheddar chips: 2C”; 3C=54g/3= 18g/C x 2C=36g

36. POTATOES, FRENCH-FRIED:
NutrIV#5800-potato-french fried-restaurant cooked: 1C=57g; 1½C=86g; 2C-114g
3PF as STD:
1 medium bag; about 1-1/3C=85g; 1 small bag; about **1C=74g**; (1-½C=111g)
1 large bag; about 2C=114g (**note: 1C used as central STD for conversions)

417-1100-05: “french fries: 1½C”; 3PF=(1C=74g)x1.5C=111g
417-1300-09: “Log Jam restaurant french fries: ‘**8oz**’”; “8oz”=227g **note:(8oz interpreted as 1C)--3PF=1C=74g
423-1240-04: “fries(basket): **~30**”; NutrIV#649: potato-fried-prepared from frozen-5g/item(selected because listed ‘per item’): 30x5g=150g
423-1640-10: “seasoned **crisscut** fries: ~12 fries”; NutrIV#10797-fries-crisscut-large-carl’s jr=162g (serving)---~½ serving=81g
424-1120-03: “french fries: 2-½C”; 3PF=2-½x74g/C=185g
625-1200-06: “Perkins french fries: ½ plate/like Am.fries: 2C”; 3PF=74g/Cx2C=148g
625-1300-07: “Country Kitchen french fries: 2C”; 3PF=(1C=74g)x2C=148g
701-1100-01: “Perkins french fries: 1C”; 3PF=1C=74g
701-1520-08: “french fries(american-cut): (2”x3”x2”h); (?)---not used

40. POTATOES, MASHED, OR OTHER MASHED ROOT VEGETABLES:
NutrIV#651---potato-mashed-from raw-with milk= ¼C=52.5g
3PF as STD:
1C=262g; ½C=127g; 1/3C=85g

416-1440-10: “mashed potatoes-¼C”; 3PF=¼Cx262g/C=66g

41. POTATOES, SCALLOPED, OR OTHER VEGETABLES IN SAUCE:
USDA#11372-potatoes, scalloped, home-prepared with butter: 1C=245g
3PF as STD:
1C=196g; ½C=94g; ¾C=340g

417-1400-11: “au gratin potatoes-‘2 ice cream scoops’/~1¼C”; 3PF as STD=1C=196gx1-¼C=245g
424-1100-02: “potato salad-2C”; 3PF as STD=1C=196g x2C=392g

88. HAMBURGER, FAST FOOD (BUN):
**COMPARISON: NutrIV#6833: bun-hamburger/hotdog-fast food=1oz=28.5g;
USDA#18350—rolls, hamburger or hotdog, plain—1 roll=43g
3PF as STD:

1 small sandwich(bun only)=62g	(measured from book: 3-½”dia)
1 large sandwich(bun only)=96g	(measured from book: 3-⅝”dia)
1 med. sandwich(bun only)=85g	(measured from book: 3-⅝”dia)

417-1100-05: “hamburger bun(2-5/8”X4”)”: 1”; 3PF=85g
424-1100-02: “bun (4”dia): 2”; 3PF=85gx2=170g
723-1320-03: “bun (1”x4”dia): 1”; 3PF=85g

89. HOT DOG BUN:
USDA#18350—rolls, hamburger or hotdog, plain—1 roll=43g
3PF as STD: (note: calculated by subtracting hotdog(only) listed in Table one, *in grams* from total sandwich *in grams*)
1 medium bun: 42g; **1 small bun: 44g(? bookerror)**; 1 large bun: 59g

417-0940-01: “hotdog bun (6½”X2”)”; 3PF=42g
625-1100-04: “Holsom brand hotdog bun: 1”; 3PF=44g
625-1600-11: “hotdog bun(5½”x2”x1”): 1”; 3PF=44g
702-1120-03: “Don’s white hotdog buns: 2”; 3PF=44g x2=88g
702-1140-04: “SuperValue white hotdog buns: 2”; 3PF=44g x2=88g
706-1400-02: “hotdog buns—std--same size as hotdog: 2”; 3PF=based on picture, 1st picture(portion 1)—hotdog & bun=same size=42gx2=84g

90. LASAGNA OR SIMILAR CASSEROLES:
3PF as STD:
1 medium portion=255g; 1 large portion=340g; 1 small portion (~1C)=215g

416-0900-01: Pasta Primavera (Quantity Food Production class—pre-portioned serving—~6oz)--#2331-pasta-primavera-STOUFFERS(Nutritionist IV); 6oz=170g; 3PF as STD=1C=215g÷8(8oz/C)=26.9g/ozx6oz=161g

91. MACARONI AND CHEESE OR SIMLAR ITEMS:
NutrIV#442—macaroni & cheese-enriched-home recipe: 1C=200g
NutrIV#448--noodles-egg-enriched-cooked: 1C=160g
3PF as STD:
½C=130g; 1C=245g; 2C=450g (1–½C=1.5x245g/C=368g)

416-1240-06: "Hamburger Helper(3 scoops)—~2C"; NutrIV#13853—Hamburger Helper-chili mac-prep-Gen Mill; 2C=514g; 3PF=2C=450g
417-1040-04: "Lipton sauce & noodles(chicken flavor)—1½C"; 3PF=1.5C=368g
423-0900-01: "IGA macaroni & cheese—1C"; 3PF=1C=245g
423-1240-04: "macaroni & cheese: 1C"; 3PF=1C=245g

92-93: PIZZA, THIN- AND THICK-CRUST:
3PF as STD:

1 medium slice, thick crust:	**144g**;	1 medium slice, thin crust:	**140g**
2 medium slices, thick crust:	**287g**;	2 medium slices, thin crust:	**290g**
1 large slice, thick crust:	**226g**;	1 large slice, thin crust:	**220g**

416-1220-05: "Tombstone stuffed crust pepperoni pizza—(pizza cut in 8sl)—3sl"—per manufacturer—svg sz:1/6th of pizza(133g); x6=798g/8sl=99.75g/sl x 2sl=199.5g (200g); 3PF=3xmed.slice, thick crust=3x144g each=432g
416-1300-07: "Ted's pizza squares: 2 ½"X3" (5 pieces)—crust only(w/tomatoes & sauce—no cheese) **not used---unequal representation
416-1500-11: "Jacks pepperoni pizza—thin crust: 2 sl"; per manufacturer—Jacks 'original' pepperoni pizza--¼ pizza=121g (2sl); 3PF=2xmed.slice, thin crust=2x140g each=280g
416-1600-13: "Tombstone stuffed crust pepperoni pizza—~4 ¼"X5"/sl: 'cut into 8ths': 1sl & 2sl"; per manufacturer---svg sz: 1/6th of pizza(133g); x6=798g/8sl=99.75g/sl; 2sl=199.5g (200g); 3PF=3xmed.slices, thick crust=3x144g each=432g
417-1000-02: "Ted's pizza: sausage & pepperoni(3"X4"squares)—3 pieces(9"X12"total)"; (size comparable to 2 slices)---3PF=2½xmed.slice, thin crust=2½x140g=350g
424-1000-01: "DiGiorno pizza(cheese)—2 sl"; per manufacturer: 1 svg=1/6th of pizza=133g (x6=798g/8=99.75g) x2slices=199.5g (200g); 3PF=2xmed.slices, thick crust=2x144g=288g

625-1140-05: “8” pizza w/toppings; thin crust”; reference used: per manufacturer, Bernatellos 9” thin & crispy, sausage & pepperoni: svg sz: ½ pizza (126g); 9oz=255g; 3PF=comparable to 3 med.slices, thin crust=3x140g/slice=420g
701-1620-10: “Pizza Hut: medium(12”)-thick crust-pepperoni/pineapple: 4 slices”; www.pizzahut.com website: “America’s favorite thick crust pizza”—pepperoni=122g/slx4=488g
*note: 3/17/02--per phone call to Pizza Hut re: # of slices per pizza: Med=8 slices; Large=12 slices (exceptions: (comes in large only): Stuffed crust & Big New Yorker=8 slices/pizza); 3PF=4xlarge slices, thick crust=4x226g=880g
701-1640-11: “Roma pizza-Magic Crust(thick crust)-pepperoni: ½ pizza; (cut in 6)”; per manufacturer: svg sz: 1/5th pizza(123g) x5=615g/pizza x ½ =308g; 3PF=3xmed.slices, thick crust=3x226g=678g
702-1000-01: “Bernatellos: ½# supreme: ate ¾; 6 slices”; per manufacturer: “super deluxe”--svg size: 1/5th of pizza(134g) x 5=670g/pizza x ¾ =503g; 3PF=6xmed.slices, thin crust=6x140g=840g
*702-1140-04: “(no brand) sausage-thin crust pizza : ¼ of pizza—2 slices”; per manufacturer: (sausage--Tombstone or Red Baron) 79g/sl x 2=158g; 3PF=2xmed.slices, thin crust=280g
*702-1140-04: “Pizza Hut: deep dish(3-½”x5-½ x 1-½”): 2 pieces”; www.pizzahut.com website: “Ultimate Lover’s hand tossed=119g/sl x 2=238g; 3PF=2xmed.slices, thick crust=2x144g=288g (*combined=568g)
702-1400-05: “Tombstone-pepperoni(thin crust)-cut in 8: 3 sl”; per manufacturer: thin crust pepperoni: svg size: ¼th of pizza(138g) x 4=552g / 8=69g/slice x 3 slices=207g; 3PF=3xmed.slices, thin crust=3x140g/slice=420g
721-1340-08: “Pizza Hut-large-16”-pepperoni-stuffed crust pizza—cut in 8ths: 2 slices”; per website: 154g/sl x 2 slices=308g; 3PF=2xlarge slices, thick crust=2x226g=452g
722-1320-03: “pizza-pepperoni(brand not known)—½”x8”x9½”--1 sl”; 1xlarge slice, thick crust=226g
722-1340-04: “Tombstone--Supreme-12” pizza cut in 8ths—1 sl”; per manufacturer: 12”Supreme=svg sz=1/5th of pizza=129g x5=645g/pizza /8=80.6g/sl (81); 3PF=1xmed.slice, thin crust=1x140g=140g
723-1300-02: “frzn BBQ chicken/white cheese-SM—thin crust pizza--1 sl”; 3PF=1xmed.slice, thin crust=1x140g=140g
804-1030-01: “Dominos sausage & pepperoni(LG—12pieces)-had 5”x8”square”; per www.dominos.com website: large=14”; svg sz=2 of 8 sl; no gram weights listed; literature received from company by request=hand-tossed cheese pizza: svg sz: 219g(2 of 8 slices) (+additional weight for sausage/pepperoni--?); 3PF=1xlarge, thick crust=1x226g=226g

96. SUBMARINE SANDWICH:
Submarine sandwich values obtained from www.subway.com to compare weights; NutrIV also checked for comparison purposes.

3PF as STD:
3 ½”=139g (÷½”=19.857g)
12”=530g (÷½”=22.8g)
6”=273g (÷½”=22.75g)

19.857g+22.8g+22.75g=64.687÷3=***21.56g average per ½”sandwich*** (round to 22g)

417-1120-06: “salami/bologna sub-sandwich(3”X3½”X5”)”—NutrIV#4023-sandwich-cold cut trio-6”-white-Subway: 227g; 3PF=5”(x22g/½”)=220g
417-1340-10: “turkey/ham sub-sandwich(6”)—NutrIV#15834-sandwich-turkey/ham-6”-white-Subway: 213g; 3PF=6”=273g
423-1220-03: “turkey/swiss sub-sandwich(½)—NutrIV#16376-sandwich-turkey-6”-white-Subway: 213g; 3PF=6”=273g
424-1340-06: “turkey/ham sub-sandwich(2½”x3”x6½”)”; NutrIV#15834-sandwich-turkey/ham-6”-white-Subway: 213g; 3PF= 6½”(x22g/½”)=286g
706-1100-01: “Subway-6”-ham/cheese”; STD Subway 6”ham=219g; 3PF=6”=273g
721-1340-08: “6”Subway-ham/cheese”; STD Subway 6”ham=219g; 3PF=6”=273g
723-0800-01: “Subway-6”-meatballs & works”; STD Subway 6”meatball=284g; 3PF=6”=273g