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The Influence of Dietary Restraint, Social Desirability, and Food Type on Accuracy of Reported Dietary Intake

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To the Graduate Council:

I am submitting herewith a thesis written by Ashlee Hirt Schoch entitled "The Influence of Dietary Restraint, Social Desirability, and Food Type on Accuracy of Reported Dietary Intake." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

Hollie A. Raynor, Major Professor

We have read this thesis and recommend its acceptance:

Betsy Haughton, Katie Kavanagh

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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The Influence of Dietary Restraint, Social Desirability, and Food Type on Accuracy of Reported Dietary Intake

A Thesis Presented for
the Master of Science
Degree
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Ashlee Hirt Schoch
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ABSTRACT

Underreporting in dietary assessment has been linked to dietary restraint (DR) and social desirability (SD). Thus, this study investigated accuracy of reporting energy intake (EI) of a laboratory meal during a 24-hour dietary recall (24HR) in 38 healthy, college-aged (20.3 ± 1.7 years), normal-weight women (22.4 ± 1.8 kg/m^2), categorized as high or low in DR and SD.

Participants consumed a meal (sandwich wrap, chips, fruit, and ice cream) and completed a telephone 24HR. Accuracy of reported intake = (((reported intake - measured intake)/measured intake) x 100) [positive numbers = overreporting].

Overreporting of EI was found in all groups (meal accuracy rate = 43.1 ± 49.9%). An interaction of SD x individual foods ($p < 0.05$) occurred. SD-High as compared to SD-Low more accurately reported EI of chips (19.8 ± 56.2% vs. 117.1 ± 141.3%, $p < 0.05$) and ice cream (17.2 ± 78.2% vs. 71.6 ± 82.7%, $p < 0.05$). An effect of SD occurred, where SD-High as compared to SD-Low more accurately reported meal EI (29.8 ± 48.2% vs. 58.0 ± 48.8%, $p < 0.05$). For measured meal EI, an effect of DR occurred where DR-High consumed less than DR-Low (437 ± 169 kcals vs. 559 ± 207 kcals, $p < 0.05$). An interaction of DR x food type ($p < 0.05$) occurred where DR-High as compared to DR-Low consumed less sandwich wrap (156 ± 63 kcals vs. 210 ± 76 kcals, $p < 0.05$) and ice cream (126 ±73 kcals vs. 190 ± 106 kcals, $p < 0.05$). For reported meal EI, an effect of DR occurred where DR-High reported consuming less than DR-Low (561 ± 200 kcals vs. 818 ± 362 kcals, $p < 0.05$). An interaction of DR x individual foods ($p < 0.05$) occurred where DR-High reported consuming less ice cream than DR-Low (145 ± 91 kcals vs. 302 ± 235 kcals, $p < 0.05$).

Overreporting EI from a laboratory meal was prevalent. However, those high in SD were more accurate in reporting intake, particularly of high-fat foods. Future research is needed to investigate factors that contribute to overreporting.

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Introduction

Assessing dietary intake is an important component of nutrition-focused healthcare, research and policy development, as it provides information regarding dietary intake that is used for making decisions at the individual and population level (1-4). For dietary assessment information to be used appropriately, it needs to be accurate and the inherent limitations of assessment methods need to be well understood (3, 5, 6). Many methods have been developed to assess dietary intake, including the food record (FR), food frequency questionnaire (FFQ), and 24-hour dietary recall (24HR) (3, 4). For adults, the most frequently used methods that provide an overall view of dietary intake rely on self-reported information, which is subject to potential inaccuracies and biases (1, 5-8). Understanding factors that influence the accuracy of dietary assessment methods is important to move the field of dietary assessment forward. As research is conducted to understand factors that influence accuracy of reported intake, improvements in dietary assessment methods are constantly made to reduce inaccuracies and biases and therefore strengthen the process of dietary assessment.

Dietary Assessment Methods

Food Records

Food records are a method of dietary assessment where an individual records food and beverage intake over a specified, prospective period of time (3, 4). Ideally, foods and beverages are recorded immediately following each eating occasion. Prior to the start of the recording period, individuals are instructed on the level of detail to record. When the recording period ends, each FR is reviewed with the individual to clarify details and ask about potentially omitted items (4). The level of detail most often requested of the respondent includes the specific food or beverage, brand name, preparation method, ingredients in mixed foods and the amount consumed (3, 4). The amounts of food and beverage consumed are usually obtained by estimation using models or pictures or by measurement using a food scale or common household measuring cups and spoons (3, 4). An open-ended format is more commonly used for FRs, however some more structured formats that incorporate food lists or categories have been developed (4, 9). To measure the current diet of an individual, multiple (3-4) FRs are necessary due to day-to-day variations (3, 4). When individual FRs are combined with other FRs from a defined group, the average intake of the group can be evaluated. For the usual intake of an individual, multiple FRs, collected across different seasons of the year, are required (3).

Due to their prospective nature, FRs have the potential for providing a high level of accuracy and thus have been frequently used as the reference in research studies (3, 4). Recording foods and beverages concurrent with consumption contributes to accuracy by eliminating the reliance on memory, and by allowing for detailed descriptions and measured portion sizes (3, 4, 10). A primary weakness of the FR method of dietary assessment is the high respondent burden of recording consumption over several days and the resulting diminished compliance to recording foods and beverages immediately following each eating occasion. When this instruction is not followed, the respondent relies on memory to complete the FR, potentially omitting foods and beverages, recording inaccurate portions, and/or providing fewer details (3, 4, 10). Researchers have found differences in the accuracy of reported energy intake (EI) between groups of motivated individuals and in randomly selected samples (11). To prevent the potential inaccuracies, researchers agree that highly motivated individuals who are willing to comply with the study demands are required (3, 4, 12). A limitation to measuring an individual's current, unaltered diet using FRs is the influence that recording dietary intake can have on an individual's eating behavior (3, 4, 10). Written FRs require literacy, which limits the use in some populations (3, 4, 10).

In an early FR validation study, Karvetti and Knuts (13) compared reported intake from a 2-day FR to observed intake reported by trained dietitians. On two days, 121 participants consumed meals cafeteria-style in a laboratory facility. All foods were weighed or measured before being placed for selection. Dietitians documented the foods selected by each participant and weighed the remaining uneaten foods. They found a high level of agreement between reported energy intake (EI) and observed EI with a mean difference of 24 ± 242 kilocalories (kcal) or a 1.3% accuracy rate (13). In contrast to these results, a recent review by Poslusna and colleagues (14) evaluated studies of dietary assessment conducted up to March 2008 and found underreporting in FRs from 12% to 44%.

To improve the accuracy of the FR method, Koebnick and colleagues (9) developed a semiquantitative FR that included 270 food items categorized in 27 food groups. The researchers validated the FR by comparing EI recorded for 4 days to energy expenditure (EE) obtained using the doubly labeled water (DLW) method in 29 participants. Results showed a mean difference between EI and EE of -1.7 ± 2.6 MJ (-406.5 ± 621.6 kcals), indicating a degree of underreporting of EI. The researchers concluded that their semiquantitative FR provides acceptable estimation of EI for groups of individuals (9).

Food Frequency Questionnaires

Food frequency questionnaires (FFQ) assess long-term dietary intake for a specified, retrospective period of time, typically 6-12 months, thus measuring usual intake rather than current diet. Using a pre-defined list, individuals report how often they consume foods and beverages (3, 15, 16). The simplest FFQ includes a food list and frequency response categories based on standard serving sizes (3, 16). Several semi-quantitative FFQs have been developed to incorporate options for different serving sizes (3, 4, 15, 16). Based on the assessment objective, the food list developed for a FFQ can range from extensive, measuring total intake, to targeted, measuring select nutrients (16). In addition, the food list can be adapted to different populations based on cultural food preferences (4, 16).

Based on several benefits, FFQs are commonly used in large epidemiologic studies (3, 4, 16). Lower costs are associated with FFQs because many can be self-administered by the respondent, lowering personnel costs. In addition, different forms of FFQs, such as printed or computer-based, allow easy, low-cost distribution to a large number of respondents (3, 4, 16). Many FFQs can be completed within an hour so the respondent burden is lower compared to some other dietary assessment methods (3, 4). Because FFQs are retrospective, individuals' unaltered, usual diets are measured, and the data obtained allows ranking of individuals according to their intake and calculations of average population intake (3, 4, 16). Regarding reliance on memory, Willett (16) suggested that usual diet is easier to recall compared to a specific day and Gibson (3) pointed out that the food list prompts memory. As explained by Thompson and Subar (4), several weaknesses are associated with the FFQ method of dietary assessment. One weakness is the lack of details, such as food preparation methods and portion sizes consumed. Another limitation is incomplete food lists and standard portion sizes, which can lead to inaccuracies in reported dietary intake. Mixed food dishes, such as casseroles or sandwiches, present a problem with reporting because they can be recorded individually or as a combined food, leading to omissions or double-counting (4). In addition, many FFQs require literacy so the use in some populations is limited (3).

Kroke and colleagues (17) were among the first to conduct a validation study of a self-administered FFQ compared to an objective measurement of EE obtained using the DLW method. Using a subset of 30 participants from the European Prospective Investigation into Cancer and Nutrition (EPIC) study, the researchers compared EI reported using the FFQ and EE obtained from the DLW method. The results confirmed their concern of underreporting by finding that the reported EI was 22% lower than EE. To explain some of the discrepancy the researchers pointed out the small sample size and the measuring period differences between the FFQ (1 yr) and DLW (14 d) (17).

A study by Subar and colleagues (15), using multiple 24HRs as a reference, evaluated three FFQs, including two that incorporate options for different portion sizes and one that uses single standard serving sizes. The Diet History Questionnaire (DHQ) included portion size ranges for each food item, the Block FFQ used portion quantification categories (small, medium, and large) and the Willett FFQ used standard portion sizes. The DHQ and the Block FFQ resulted in estimates of EI more similar to each other and to the reference results from the 24HRs as compared to the results from the Willett FFQ (15). Thus, the inclusion of portion size estimations strengthened the FFQ method.

24-Hour Dietary Recall

The 24HR is a method of assessment where an individual reports food and beverage intake from the previous day or 24-hour period as a trained interviewer provides prompts through a series of questions (3, 10, 18). As this method relies on memory, the prompts are designed to assist the respondent in remembering the previous day's intake (3, 4, 10). The 24HR obtains dietary information, including the specific food or beverage, brand name, preparation method, ingredients in mixed dishes and amount consumed (3, 10). To measure current diet of an individual, multiple 24HRs are required to account for day-to-day variations. Single-day 24HRs from individuals in a specific population can be combined to evaluate the average intake for that population. Multiple 24HRs collected across different seasons of the year can be used to evaluate usual intake of an individual (3, 4).

Based on several strengths, the 24HR method of dietary assessment has been used as the reference for dietary intake in many research studies and is the method most often used in national surveillance (3, 4). Among the strengths is the open-ended questioning method, which accommodates a variety of foods, food combinations, cooking methods, and measuring units (3, 4, 10). In addition, it measures the retrospective diet, so it is less likely to change the respondent's eating behaviors for the data collection period. The 24HR is interviewer-led so it does not require literacy, making it useful in different populations. On average, the 24HR interview lasts 30 minutes, which places a low burden on respondents (4, 10). Some researchers regard the short recall period as a benefit of the 24HR (4), while others consider the reliance on memory to be a limitation (10). The primary weakness of the 24HR is the associated high cost due to the requirement of a trained interviewer (4, 10).

To improve the 24HR method of dietary assessment, the U.S. Department of Agriculture (USDA) developed an automated multiple-pass method (AMPM) for 24HR, which is used in data collection for the National Health and Nutrition Examination Survey (NHANES) (18). The USDA's AMPM 24HR is continually improved and the current version has been shown to improve accuracy and reduce respondent burden (19). The Nutrition Data System for Research (NDSR), developed by the Nutrition Coordination Center (NCC), University of Minnesota, Minneapolis, Minnesota, is another automated multiple-pass system for the 24HR (20). Both NDSR and the USDA's AMPM comprise similar components in their processes, including the formation of a quick list, prompts for omissions, probes for details and a final review (18, 20).

The effectiveness of the AMPM 24HR has been validated in various studies including two conducted by Conway and colleagues (19, 21). In both of these studies, participants consumed all meals and snacks in a laboratory for one day. All food and beverages were objectively measured so the actual intake could be determined. On the day following the laboratory meals, a phone 24HR using the UDSA's AMPM was conducted with each participant. One study involved 49 women and the results found that the participants recalled their intake to within 10% of actual mean intake, thus validating the dietary assessment method (19). The other study by Conway and colleagues (21) involved 42 men and the results found no significant differences between actual intake and reported intake. Despite the positive results, the researchers urged others to continue evaluating factors that lead to reporting inaccuracies in dietary assessment (21).

Comparison of Dietary Assessment Methods

While most methods of dietary assessment share some limitations based on the reliance on self-reported information, distinct differences exist in the strengths and weaknesses (3, 4, 10). Food frequency questionnaires measure usual intake rather than current diet and are the most common method for obtaining dietary intake in large epidemiologic studies due to the associated low cost and self-administration (3, 4, 16). Because FFQs focus on usual energy intake, specific information on eating behaviors, such as eating frequency, meal/snack times, meal location, and foods consumed in a single eating occasion, is not obtained. Food records and 24HRs measure current intake of individuals or the average usual intake of a population (3, 4, 10). Both FRs and 24HRs have the ability to capture details of eating behaviors, including eating frequency, meal/snack times, meal location, and foods consumed in a single eating occasion. While FRs have tremendous potential for accuracy, the high level of respondent burden can potentially limit the attainment of accuracy (3, 4). In comparison to other methods, the 24HR has more benefits and fewer limitations and it is the most frequently used dietary assessment method in national surveillance (3, 4).

Blanton and colleagues (12) evaluated the USDA's AMPM 24HR for validity in obtaining total EI for a group. The researchers estimated total energy expenditure (TEE) using the DLW technique and used a 14-day FR as the reference EI. They also administered 2 FFQs, including the Block and the DHQ. They found that the AMPM 24HRs and the FRs were accurate within 4% of EE, with no bias found in the AMPM 24HR and a bias towards underreporting found in the FRs. Both the Block FFQ and the DHQ underestimated EE by approximately 27%. Because the study objective was to validate the AMPM 24HR with group data, the researchers pointed out that the dietary assessment methods were under optimal conditions and the study participants were highly motivated to follow protocol. The researchers concluded that the AMPM 24HR accurately measured EI in their group of highly motivated women (12).

Assessment of Accuracy in Dietary Assessment

Evaluation of the accuracy of reported dietary intake requires an objective measure of either actual EI or EE, thus accuracy can be assessed in two primary ways, including comparing reported intake to measured intake and comparing reported intake to EE (11, 14). For comparisons to actual intake, the accuracy standard for dietary assessment was established in a study conducted by Basiotis and colleagues (22), where reported intake was within 10% of actual intake, 95% of the time. Comparisons of EI to EE are based on the principle of energy balance, where EI=EE in weight-stable individuals (2, 11, 23). To evaluate the accuracy of reported EI based on calculated EE, Goldberg and colleagues (23) established cutoff points as factors of basal metabolic rate (BMR), represented by the ratio EI:BMR, to identify the minimum physical activity level (PAL) required for a healthy free-living person. In 2000, Black (24) reexamined the Goldberg cut-off values and established broader categories, ranging from 1.2 for bed-/chair-bound to 2.4 for the highest level of sustainable activity.

Reported Intake vs. Measured Intake

To evaluate reporting accuracy, reported dietary intake can be compared to an objective measure of actual dietary intake (14, 25). Actual dietary intake can be obtained by weighing foods before and after an eating occasion and then, calculating the difference (13, 19, 21). The reporting accuracy can be calculated using the following formula: (((reported intake-measured intake)/measured intake) * 100). This method has been used in several studies including one by Conway and colleagues (19), where participants selected pre-measured foods from a buffet and returned the uneaten amounts, which were weighed to determine the amount consumed. Because observation has the potential to influence eating behavior and reported intake, individuals being assessed should be unaware that their consumption is being measured (25).

Reported Intake vs. Energy Expenditure

Accuracy of reported dietary intake can be evaluated by comparing reported EI to EE, based on the concept of energy balance, where EI=EE (2). Total energy expenditure is a total of all the energy used during a time period, generally 24 hours, and is comprised of three components (26, 27). The largest component of TEE is BMR or resting energy expenditure (REE), which is energy used to sustain life. Activity energy expenditure (AEE) is the second largest contributor to TEE and is the energy expended during activity for daily life and activity for exercise. Diet-induced energy expenditure (DEE) accounts for the thermal effect of food, generally a very small amount of energy (26, 27). Total energy expenditure can be assessed using direct calorimetry, indirect calorimetry, DLW, and standard prediction equations (2, 23, 26, 27).

Direct calorimetry measures heat generated by an individual occupying a chamber, known as a calorimeter (23, 27). Because of the time required and the laboratory equipment involved, direct calorimetry is rarely used (27). Indirect calorimetry estimates TEE using measurements of respiratory gas exchange, including carbon dioxide (CO_2) production and oxygen (O_2) consumption, and standard equations. Respiratory gas exchange of CO_2 and O_2 can be measured in a respiratory chamber or using portable equipment, such as a ventilated hood

(27). The DLW technique is another method used to estimate TEE based on the production of CO_2, an end product in substrate metabolism (6, 27, 28). In this technique, a baseline urine sample is collected, the subject ingests water enriched with labeled isotopes, deuterium (^2H) and oxygen-18 (^{18}O), and subsequent urine samples are taken, either daily or at the start and end of the test period. The urine samples are analyzed for the rate of elimination of the isotopes, which provides data from which CO_2 production can be calculated. Using total CO_2 production, TEE can be calculated using standard equations (28).

The DLW water technique is considered the gold standard for obtaining EE in free-living individuals (6, 14, 26). Since the first application to humans in 1982 by Schoeller and van Santen (29), the DLW technique has been validated for accuracy and precision in numerous studies (28, 30, 31). In 1990, Schoeller (2) reviewed current studies and found accuracy rates of within 1% and precision rates of 3-6%. In a review by Goldberg and colleagues (23), data combined from a collection of studies showed a rate of overestimation of 2-3%. Two studies from the early 1990s compared EE obtained using the DLW technique to EE obtained from a respiratory chamber (30, 31). Seale and colleagues (31) evaluated 4 females and 5 males who occupied a respiratory chamber for 7 days. Energy expenditure measured by indirect calorimetry was 11.00 ± 1.79 MJ compared to 11.17 ± 1.85 MJ and 11.07 ± 1.76 MJ calculated using two different DLW methods (31). Based on the small differences found, the researchers concluded the validity of DLW for obtaining EE (31). Using similar methods, Ravussin and colleagues (30) evaluated the DLW technique on 12 lean and obese males. As compared to EE obtained using respiratory gas exchange measured in a metabolic chamber, DLW overestimated EE by 2.9% in the lean subjects and underestimated EE by 4.4% in the obese subjects (30). While the

DLW technique provides an accurate, objective tool that is easy to use with free-living subjects, the high cost and laboratory requirements prevent it from becoming a routinely used tool (6, 23, 26).

Another commonly used method for obtaining EE is estimation using equations that incorporate an individual's age, weight, height, gender, and physical activity level (PAL) (26, 32-35). Equations provide a practical, low cost method for obtaining EE for use in research and by clinicians (26). Many equations estimate BMR and then apply a multiplication factor to incorporate the individual's PAL (26, 33). In 1985, Schofield and colleagues (32) published equations for predicting BMR based on body weight, age, and gender. These equations have been widely used in research (14, 23) and were adopted by the Food and Agriculture Organization/World Health Organization/United Nations University (FAO/WHO/UNU) Joint Committee (23, 33). In 2002, the Food and Nutrition Board (FNB) of the Institute of Medicine (IOM) developed a new method to predict TEE, called estimated energy requirement (EER) (34), as part of the dietary reference intakes (DRI) (26, 36). Estimated energy requirement uses age, gender, weight, height and PAL (34) and the prediction equations are based on studies using DLW and indirect calorimetry (26).

Several studies have been conducted to validate EE equations. In one study, Warwick and colleagues (37) compared EE obtained using a simplified FAO/WHO/UNU factorial method to EE obtained from indirect calorimetry in 13 study participants. They found no significant differences between measured EE and predicted EE (37). In contrast, a study by Henry (33) noted that a survey of studies from 1980 to 2000 found that the 1985 FAO/WHO/UNU equations overestimated BMR. Alfonzo-Gonzalez and colleagues (35) evaluated EE in two groups of men and women using indirect calorimetry, the FAO/WHO/UNU equation, and EER. They found that the FAO/WHO/UNU equation overestimated EE compared to indirect calorimetry and that the EER estimate was significantly lower than the FAO/WHO/UNU estimate (35). Researchers agree that prediction equations provide useful and practical methods for estimating EE, however study into new equations and the appropriate PAL factor continues (26, 33).

Evaluation of Underreporting in 24-Hour Recalls

When the 24HR is compared to objective measures of EE, the 24HR generally shows that underreporting is common (8, 38, 39). Tran and colleagues (8) conducted a study to validate telephone-administered multiple-pass 24HRs as an effective mode comparable to the traditional in-person mode. Their results validated telephone administration as an effective mode, however when they compared reported dietary intake to EE obtained with DLW, they found significant underreporting in their sample of women (8). In another study that validated the effectiveness of the telephone multiple-pass 24HR, Yanek and colleagues (38) compared dietary intake from 24HRs to EE calculated using the Schofield equations (32). They found high rates of underreporting in their sample of 185 urban African-American women (38).

Many factors have been hypothesized to affect the accuracy of self-reported intake. One factor believed to influence accuracy of reporting is individual-level characteristics. For example, Tooze and colleagues (39) studied underreporting related to psychosocial predictors, including fear of negative evaluation, body size, social desirability (SD), and dietary restraint (DR). Reported dietary intake assessed by 24HR was compared to EE measured by DLW to identify accurate reporters and underreporters. The results found underreporting in 34% of women and 11% of men. Several psychosocial constructs were found to be predictors of underreporting, including DR, SD, and body mass index (BMI) (39). In a review, Maurer and colleagues (40) examined current research on psychosocial and behavioral characteristics and the influence on misreporting of dietary intake. They evaluated nine categories, including demographics, diet, eating behavior, SD, dieting/weight history, body image, psychology, and physical activity. Upon reviewing the literature on dietary assessment, they found a strong association with higher SD and higher DR with energy underreporting (40).

Dietary Restraint

Dietary restraint is one factor that has been linked to underreporting of dietary intake (40-43). Restrained eaters (REs) are individuals who are believed to rely on cognitive controls versus physiological cues to limit dietary intake (44). In several early studies (44-46), REs exhibited counter-regulation, in which a larger amount of food is consumed following consumption of a high-calorie food or meal, known as a preload, as compared to consumption following no preload. Unrestrained eaters (UREs), who are believed to regulate intake more to physiological cues than cognitive control, consume less following a high-calorie food or meal as compared to consumption following no preload. This style of eating is considered to be more in response to physiological needs (46). It is hypothesized that counter-regulation occurs in REs because the preload disrupts the cognitive control over eating, and as the control over eating is lost, overeating occurs (44, 46).

Three assessment tools have been developed to assess DR. The Restraint Scale (RS) (47) was originally developed to identify “dieters,” however subsequent research found that it identified those who cycle between restrictive eating and excessive eating (48, 49), and thus identifies unsuccessful "dieters." Two assessment tools that are currently more widely accepted include the Three Factor Eating Questionnaire - Restraint subscale (TFEQ-R) (50) and the Dutch Restrained Eating Scale (DRES) (51), both which measure DR as a separate construct. The TFEQ-R and the DRES are believed to identify successful "dieters," those individuals who successfully and consistently reduce their intake, as shown by weight loss and weight loss maintenance (48).

Influence of Dietary Restraint on Reporting Dietary Intake

The results from many research studies have shown that individuals who are high in DR are more likely to underreport dietary intake (41, 43, 52, 53). Several of these studies have evaluated underreporting of dietary intake by comparing self-reported EI to estimated EE. Asbeck and colleagues (43) examined severe underreporting and the influence of eating behaviors in 83 normal weight men and women. Energy intake was self-reported and EE was measured using indirect calorimetry. The German version of the TFEQ by Stunkard and Messick (50) was administered to assess DR. Severe underreporting (>20%) occurred in 37% of the participants, with a greater percentage of women, 49%, underreporting. In addition, underreporting was more pronounced in those participants with a higher restraint score (43).

Rennie and colleagues (41) examined the association between underreporting, DR, and engagement in current dieting to lose weight using a random sample of 668 men and 826 women participating in the National Diet and Nutrition Survey (NDNS) 2000. For 7 consecutive days, participants kept a weighed FR and recorded physical activity. Energy expenditure was calculated using EER formulas from the DRIs (34). Results showed that a greater proportion of both men and women categorized as underreporters (URs) had high DR scores and were dieting currently to lose weight. When compared to women classified as low-restrained, only lean high-restrained women significantly underreported (41). In another study, de Castro (52) evaluated the association of DR, assessed using the TFEQ-R (50), on different levels of dietary reporting in a sample of 929 men and women. Self-reported EI from a 7-day FR was compared to estimated BMR calculated using Schofield equations (32). The study participants were divided into 5 groups based on the ratio EI:BMR. The results found that the low energy reporters (LERs) had significantly higher DR scores compared to the high energy reporters (HERs) (52).

Lafay and colleagues (53) studied determinants of dietary underreporting, including DR, in a sample of 501 women and 529 men. Dietary restraint was evaluated by asking the question, "do you have to reduce food intake in order to maintain your body weight?" with response options of "yes" or "no." A 3-day FR was used to assess EI and BMR was calculated using Schofield equations (32). The results found DR to be a significant factor related to underreporting of dietary intake with an odds ratio of 2.43 after adjusting for sex, age, BMI and interactions (53).

Krebs-Smith and colleagues (54) examined differences in reported dietary intake between LERs and non-low energy reporters (non-LER). Dietary data was obtained on 8334 participants from the USDA's Continuing Survey of Food Intakes by Individuals (CSFII) 1994-96. Of the participants, 1224 were identified as LERs using the Schofield formula (32) with a cutoff of 80% of BMR. This study found that LERs were more likely to be female. Those identified as LERs reported fewer foods, lower frequency of certain foods, and smaller portions of foods. While DR was not measured, the researchers hypothesized that some of these results suggested a restrained pattern of eating (54).

Jansen (42) evaluated underreporting and DR by comparing objectively measured EI to reported EI. In this study, 30 females, both normal and overweight, were categorized as REs or UREs based on the DRES (51). Participants taste-tested 10 different foods and estimated their EI. Participants were evaluated based on the amount of energy they consumed, the amount of energy they reported that they consumed, and their perception of how much they consumed. The participants classified as RE consumed more energy (571 kcals) as compared to those classified as URE (419 kcals). While both groups of participants underestimated their EI, the difference between actual EI and estimated EI was significantly larger for the RE participants (-66%) compared to URE participants (-32%). In addition, the perception of amount eaten was similar between the two groups despite the differences (42).

Results from these studies show a greater occurrence of underreporting among those with high restraint scores. However, not all studies have found an association between DR and underreporting. Ard and colleagues (55) examined the association between DR and accuracy of the 24HR in a sample of 150 non-Hispanic white men and women. In this study, participants consumed all meals and snacks in a laboratory setting and a 24HR was conducted the following day. The reported dietary intake was compared to actual dietary intake obtained from pre- and post-weighed foods and beverages. The results found no significant association between the accuracy of reported dietary intake and DR. Both men and women overreported consumption, however the reported dietary intake was within the 10% accuracy standard (55). In another study, Taren and colleagues (56) examined the association of psychological characteristics and underreporting in 37 women. Dietary intake was assessed using a 3-day FR and energy expenditure was estimated using the DLW method. No association between DR and underreporting was found (56). Thus, the conflicting results of these studies and the wealth of literature that supports an association between DR and underreporting of dietary intake reveals the need for more research in this area.

Social Desirability

Social desirability is another individual characteristic that has been associated with underreporting (39, 40). Social desirability is a personality trait where approval is sought by responding in a socially favorable manner, whether true or not (57). Social desirability is currently assessed using the Marlowe and Crowne Social Desirability Scale (M-C SDS) (57), which was developed based on culturally acceptable behaviors that are unlikely to happen, thus identifying those who seek social favor. In addition, several short forms have been developed from the M-C SDS, including the M-C Form B (58).

Influence of Social Desirability on Reporting Dietary Intake

Social desirability is a factor many studies have linked to underreporting of dietary intake (39, 56, 59-61). Several studies have compared reported dietary intake to objective measures of EE. Novotny and colleagues (59) examined personality characteristics associated with underreporting of EI in 52 women and 46 men where dietary intake was reported via 24HRs and EE was measured by the DLW method or the intake balance method. Participants completed questionnaires, including an assessment of SD. Results found a gender difference in underreporting where 85% of women underreported EI as compared to 61% in men. Moreover, an inverse relationship between SD and underreporting in women was reported, with -26 kcal underreported for each additional point on the SD scale (59). Taren and colleagues (56) also examined bias in reporting EI and the association with SD scores in 37 women. When compared to EE obtained from the DLW method, the results showed that EI, obtained from FRs, was underreported by an average of 258 kcal/day and underreporting was associated with SD. In addition, the results showed a slight weight gain in URs and a slight weight loss in overreporters (ORs), however the differences were not statistically significant (56).

Tooze and colleagues (39) evaluated psychosocial characteristics associated with underreporting of dietary intake in sample of 484 men and women. Several individual characteristics were assessed, including SD using the M-C SDS (57). Energy intake, obtained from two 24HRs, was compared to EE, obtained from the DLW method, to identify underreporting. The results found that, in women, higher SD was associated with greater odds of underreporting (39). Horner and colleagues (61) also evaluated personality characteristics, including SD assessed with the M-C SDS (57), associated with mis-reporting of EI in as sample of 102 postmenopausal women. Dietary intake was assessed using a FFQ and EE was estimated using indirect calorimetry. The results found an association between SD and underreporting, where women with high SD scores were more likely to underreport EI as compared to women with low SD scores (61).

In another study, Scagliusi and colleagues (60) studied underreporting of dietary intake in 38 healthy women in Brazil. Dietary intake was reported using 7-day FR and participants were trained on procedures for recording intake, including portion estimation. Energy expenditure was calculated using data from heart rate monitoring and respiratory gas exchange. Reported EI and calculated EE were compared to identify URs. Of the 38 participants, 49% underreported EI by about 21% with 14% reporting intake lower than resting metabolic rate. The results revealed a negative correlation between SD and the ratio of EI to EE (60).

Influence of Dietary Restraint and Social Desirability on Reporting Intake of Food Types

Besides impacting on overall EI reported, research suggests that DR and SD influence the types of foods reported during dietary assessment. Several studies have shown a lower reported intake, either by fewer mentions or smaller portion sizes, of certain foods that are perceived as unhealthy (52, 60, 62, 63). Dietary restraint can lead to dichotomous thinking where foods are considered "good/healthy" or "bad/unhealthy" (44). A pattern suggesting dichotomous thinking in foods was found in the study by de Castro (52) where the influence of DR on different levels of dietary reporting was evaluated in a sample of 929 men and women. The LERs who had higher DR scores reported a higher percentage intakes of healthier foods, including vegetables, chicken fish, and bean and lower intakes of less healthy foods, including cheese, ice cream, cookies, nuts, chips, and snack foods, as compared to the HERs who had lower DR scores (52).

Moreira and colleagues (63) examined DR, dietary intake, and eating behavior in 380 college students, of which 60% were female. The results found that women categorized as REs reported a lower intake of bread and pastries compared to UREs (63). In the study of 8334 adults participating in the CSFII, Krebs-Smith and colleagues (54) found that when compared to non-LERs, LERs reported fewer total foods, less frequency of certain foods and smaller portions. For example, only 10% of LERs reported cake or pie compared to 30% non-LERs and 20% of

LERs reported chips, popcorn or pretzels compared to 39% of non-LERs. LERs also reported smaller portions compared to non-LERs with chips, popcorn, and pretzels 40% lower and several grain products 20-30% lower (54).

Lafay and colleagues (62) examined the consumption of foods considered less healthy by comparing dietary intake of URs and non-underreporters (non-URs). The participants consisted of 1033 men and women who completed a 3-day FR using household measures for portion estimation. Underreporters were identified by a ratio of EI to the estimated BMR lower than 1.05. Approximately 16% of the participants underreported their dietary intake. Compared to the non-URs, URs reported consumption of fewer snacks and sweetened beverages and smaller portion sizes of high fat foods, such as cheese, butter, French fries, processed meats, cakes and pastries. Lafay and colleagues (62) explained their results of underreporting as linked to three factors, including less frequency of specific food types, underestimation of food portions, and fewer between-meal snacks. Based on the pattern of underreporting, they hypothesized that individual characteristics, such as concern about body weight and SD, may be a stronger factor than inaccurate portion estimations on underreporting dietary intake (62). A similar pattern was found in the study of 38 Brazilian women by Scagliusi and colleagues (60), where underreporting was correlated to SD. When compared to non-URs, URs reported less frequent consumption of some “unhealthy” foods, with sweets and fries reaching statistically significance (60).

CONCLUSION

Summary

The results of these studies show a prevalence of underreporting EI when the participant shows patterns of restrained eating or evidence of high SD. Underreporting occurs from reporting a lower frequency of consumption of foods, smaller portions consumed and/or fewer between-meal snacks (59, 60, 62, 63). Many hypotheses regarding the factors associated with underreporting have been presented. These hypotheses include the association to several psychosocial characteristics, including DR and SD (39, 40). While previous studies have examined the impact of these factors singularly on accuracy of reported intake, only one study has examined the influence of the interaction of DR and SD on accuracy of reported intake. In this study, Tooze and colleagues (39) found an interaction between DR and SD in men, but not in women. They reported an inverse relationship between DR and SD, where men high in SD were more likely to underreport dietary intake when DR was low (39). However, many researchers suggest a greater prevalence of underreporting among women as compared to men (1, 43, 59). Thus, the purpose of the present study was to evaluate how DR and SD interact to influence the accuracy of reporting consumption of a laboratory meal during a 24HR in women.

Participants included 38 healthy, college-age females of normal weight based on BMI (weight (kg)/height (m) ^{2}) (18.5-24.9). During an eligibility screening, participants were categorized as high or low based on DR score (DR-H, DR-L) as assessed by the TFEQ-R (50) and as high or low based on SD score (SD-H, SD-L) as assessed by the M-C SDS Form B (58). All participants consumed a lunch, composed of "healthy" and "unhealthy" foods, including sandwich wrap, chips, fruit, and ice cream. The meal was served in a laboratory setting and the amount consumed of each food in the lunch was measured objectively. On the day following the meal, participants completed a telephone 24HR. Accuracy of reported intake of the lunch was determined by comparing objectively measured intake to intake reported in the 24HR.

Specific Aims

This study examined the influence of the interaction of the two individual characteristics, DR and SD, on the accuracy of self-reported dietary intake, as well as the types of foods consumed. It was hypothesized that females categorized as high in both DR and SD would be the least accurate in reporting dietary intake and would report a lower consumption of foods perceived as unhealthy compared to females categorized as low in DR and SD. This allowed the following aims to be assessed.

1) Compare the accuracy of reported intake (measured intake of the laboratory meal to reported intake of the laboratory meal from the 24HR) by DR and SD status. It was anticipated that an interaction would occur such that DR-H/SD-H would be the least accurate in reporting dietary intake in the laboratory meal.
2) Compare the accuracy of reported food intake by food type (healthy vs. unhealthy) by DR and SD status. It was anticipated that an interaction would occur such that DR-H/SD-H would be the least accurate in reporting intake of foods perceived as "unhealthy" in the laboratory meal.

REFERENCES

REFERENCES

1. Hill RJ, Davies PS. The validity of self-reported energy intake as determined using the doubly labelled water technique. *Br J Nutr.* Apr 2001;85(4):415-430.
2. Schoeller DA. How accurate is self-reported dietary energy intake? *Nutr Rev.* Oct 1990;48(10):373-379.
3. Gibson RS. *Principles of Nutritional Assessment*. 2nd ed. New York: Oxford University Press; 2005.
4. Thompson FE, Subar AF. Dietary Assessment Methodology. In: Coulston AM, Rock CL, Monsen ER, eds. *Nutrition in the Prevention and Treatment of Disease*. San Diego: Academic Press; 2001:3-30.
5. Beaton GH. Approaches to analysis of dietary data: relationship between planned analyses and choice of methodology. *Am J Clin Nutr.* Jan 1994;59(1 Suppl):253S-261S.
6. Livingstone MB, Black AE. Markers of the validity of reported energy intake. *J Nutr.* Mar 2003;133 Suppl 3:895S-920S.
7. Kretsch MJ, Fong AK, Green MW. Behavioral and body size correlates of energy intake underreporting by obese and normal-weight women. *J Am Diet Assoc.* Mar 1999;99(3):300-306; quiz 307-308.
8. Tran KM, Johnson RK, Soultanakis RP, Matthews DE. In-person vs telephone-administered multiple-pass 24-hour recalls in women: validation with doubly labeled water. *J Am Diet Assoc.* Jul 2000;100(7):777-783.
9. Koebnick C, Wagner K, Thielecke F, et al. An easy-to-use semiquantitative food record validated for energy intake by using doubly labelled water technique. *Eur J Clin Nutr.* Sep 2005;59(9):989-995.
10. Buzzard M. 24-Hour Dietary Recall and Food Record Methods. In: Willett W, ed. *Nutritional Epidemiology*. 2 ed. New York: Oxford University Press; 1998:50-73.
11. Black AE, Prentice AM, Goldberg GR, et al. Measurements of total energy expenditure provide insights into the validity of dietary measurements of energy intake. *J Am Diet Assoc.* May 1993;93(5):572-579.
12. Blanton CA, Moshfegh AJ, Baer DJ, Kretsch MJ. The USDA Automated Multiple-Pass Method accurately estimates group total energy and nutrient intake. *J Nutr.* Oct 2006;136(10):2594-2599.
13. Karvetti RL, Knuts LR. Validity of the estimated food diary: comparison of 2-day recorded and observed food and nutrient intakes. *J Am Diet Assoc.* May 1992;92(5):580-584.
14. Poslusna K, Ruprich J, de Vries JH, Jakubikova M, van't Veer P. Misreporting of energy and micronutrient intake estimated by food records and 24 hour recalls, control and adjustment methods in practice. *Br J Nutr.* Jul 2009;101 Suppl 2:S73-85.
15. Subar AF, Thompson FE, Kipnis V, et al. Comparative validation of the Block, Willett, and National Cancer Institute food frequency questionnaires : the Eating at America's Table Study. *Am J Epidemiol.* Dec 15 2001;154(12):1089-1099.
16. Willett W. Food-Frequency Methods. In: Willett W, ed. *Nutritional Epidemiology.* Vol 30. 2 ed. New York: Oxford University Press; 1998:74-94.

17. Kroke A, Klipstein-Grobusch K, Voss S, et al. Validation of a self-administered food-frequency questionnaire administered in the European Prospective Investigation into Cancer and Nutrition (EPIC) Study: comparison of energy, protein, and macronutrient intakes estimated with the doubly labeled water, urinary nitrogen, and repeated 24-h dietary recall methods. *Am J Clin Nutr.* Oct 1999;70(4):439-447.
18. Raper N, Perloff B, Ingwersen L, Steinfeldt L, Anand J. An overview of USDA's dietary intake data system. *Journal of Food Composition and Analysis.* Jun-Aug 2004;17(3-4):545-555.
19. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr.* May 2003;77(5):1171-1178.
20. Nutrition Coordinating Center. Nutrition Data System for Research Manual. Minneapolis, Minnesota: University of Minnesota; 2007.
21. Conway JM, Ingwersen LA, Moshfegh AJ. Accuracy of dietary recall using the USDA five-step multiple-pass method in men: an observational validation study. *J Am Diet Assoc.* Apr 2004;104(4):595-603.
22. Basiotis PP, Welsh SO, Cronin FJ, Kelsay JL, Mertz W. Number of days of food intake records required to estimate individual and group nutrient intakes with defined confidence. *J Nutr.* Sep 1987;117(9):1638-1641.
23. Goldberg GR, Black AE, Jebb SA, et al. Critical evaluation of energy intake data using fundamental principles of energy physiology: 1. Derivation of cut-off limits to identify under-recording. *Eur J Clin Nutr.* Dec 1991;45(12):569-581.
24. Black AE. Critical evaluation of energy intake using the Goldberg cut-off for energy intake:basal metabolic rate. A practical guide to its calculation, use and limitations. *Int J Obes Relat Metab Disord.* Sep 2000;24(9):1119-1130.
25. Barrett-Connor E. Nutrition epidemiology: how do we know what they ate? *Am J Clin Nutr.* Jul 1991;54(1 Suppl):182S-187S.
26. Heymsfield SB, Harp JB, Rowell PN, Nguyen AM, Pietrobelli A. How much may I eat? Calorie estimates based upon energy expenditure prediction equations. *Obes Rev.* Nov 2006;7(4):361-370.
27. Johnson RK, Coward-McKenzie D. Energy Requirement Methodology. In: Coulston AM, Rock CL, Monsen ER, eds. *Nutrition in the Prevention and Treatment of Disease*. San Diego: Academic Press; 2001:31-42.
28. Schoeller DA. Measurement of energy expenditure in free-living humans by using doubly labeled water. *J Nutr.* Nov 1988;118(11):1278-1289.
29. Schoeller DA, Vansanten E. Measurement of Energy-Expenditure in Humans by Doubly Labeled Water Method. *Journal of Applied Physiology.* 1982;53(4):955-959.
30. Ravussin E, Harper IT, Rising R, Bogardus C. Energy expenditure by doubly labeled water: validation in lean and obese subjects. *Am J Physiol.* Sep 1991;261(3 Pt 1):E402-409.
31. Seale JL, Conway JM, Canary JJ. Seven-day validation of doubly labeled water method using indirect room calorimetry. *J Appl Physiol.* Jan 1993;74(1):402-409.
32. Schofield WN. Predicting basal metabolic rate, new standards and review of previous work. *Hum Nutr Clin Nutr.* 1985;39 Suppl 1:5-41.

33. Henry CJ. Basal metabolic rate studies in humans: measurement and development of new equations. *Public Health Nutr.* Oct 2005;8(7A):1133-1152.
34. Trumbo P, Schlicker S, Yates AA, Poos M. Dietary reference intakes for energy, carbohydrate, fiber, fat, fatty acids, cholesterol, protein and amino acids. *J Am Diet Assoc.* Nov 2002;102(11):1621-1630.
35. Alfonzo-Gonzalez G, Doucet E, Almeras N, Bouchard C, Tremblay A. Estimation of daily energy needs with the FAO/WHO/UNU 1985 procedures in adults: comparison to whole-body indirect calorimetry measurements. *Eur J Clin Nutr.* Aug 2004;58(8):1125-1131.
36. Britten P, Marcoe K, Yamini S, Davis C. Development of food intake patterns for the MyPyramid Food Guidance System. *J Nutr Educ Behav.* Nov-Dec 2006;38(6 Suppl):S78-92.
37. Warwick PM, Edmundson HM, Thomson ES. Prediction of energy expenditure: simplified FAO/WHO/UNU factorial method vs continuous respirometry and habitual energy intake. *Am J Clin Nutr.* Nov 1988;48(5):1188-1196.
38. Yanek LR, Moy TF, Raqueno JV, Becker DM. Comparison of the effectiveness of a telephone 24-hour dietary recall method vs an in-person method among urban African-American women. *J Am Diet Assoc.* Oct 2000;100(10):1172-1177; quiz 1155-1176.
39. Tooze JA, Subar AF, Thompson FE, Troiano R, Schatzkin A, Kipnis V. Psychosocial predictors of energy underreporting in a large doubly labeled water study. *Am J Clin Nutr.* May 2004;79(5):795-804.
40. Maurer J, Taren DL, Teixeira PJ, et al. The psychosocial and behavioral characteristics related to energy misreporting. *Nutr Rev.* Feb 2006;64(2 Pt 1):53-66.
41. Rennie KL, Siervo M, Jebb SA. Can self-reported dieting and dietary restraint identify underreporters of energy intake in dietary surveys? *J Am Diet Assoc.* Oct 2006;106(10):1667-1672.
42. Jansen A. How restrained eaters perceive the amount they eat. *Br J Clin Psychol.* Sep 1996;35 (Pt 3):381-392.
43. Asbeck I, Mast M, Bierwag A, Westenhofer J, Acheson KJ, Muller MJ. Severe underreporting of energy intake in normal weight subjects: use of an appropriate standard and relation to restrained eating. *Public Health Nutr.* Oct 2002;5(5):683-690.
44. Polivy J, Herman CP. Dieting and binging. A causal analysis. *Am Psychol.* Feb 1985;40(2):193-201.
45. Herman CP, Polivy J, Esses VM. The illusion of counter-regulation. *Appetite.* Dec 1987;9(3):161-169.
46. Herman CP, Mack D. Restrained and unrestrained eating. *J Pers.* Dec 1975;43(4):647-660.
47. Polivy J, Herman CP, Warsh S. Internal and external components of emotionality in restrained and unrestrained eaters. *J Abnorm Psychol.* Oct 1978;87(5):497-504.
48. Heatherton TF, Herman CP, Polivy J, King GA, McGree ST. The (mis)measurement of restraint: an analysis of conceptual and psychometric issues. *J Abnorm Psychol.* Feb 1988;97(1):19-28.

49. van Strien T, Herman CP, Engels RC, Larsen JK, van Leeuwe JF. Construct validation of the Restraint Scale in normal-weight and overweight females. *Appetite.* Jul 2007;49(1):109-121.
50. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res.* 1985;29(1):71-83.
51. Vanstrien T, Frijters JER, Vanstaveren WA, Defares PB, Deurenberg P. The Predictive-Validity of the Dutch Restrained Eating Scale. *International Journal of Eating Disorders.* May 1986;5(4):747-755.
52. de Castro JM. Varying levels of food energy self-reporting are associated with between-group, but not within-subject, differences in food intake. *J Nutr.* May 2006;136(5):1382-1388.
53. Lafay L, Basdevant A, Charles MA, et al. Determinants and nature of dietary underreporting in a free-living population: the Fleurbaix Laventie Ville Sante (FLVS) Study. *Int J Obes Relat Metab Disord.* Jul 1997;21(7):567-573.
54. Krebs-Smith SM, Graubard BI, Kahle LL, Subar AF, Cleveland LE, Ballard-Barbash R. Low energy reporters vs others: a comparison of reported food intakes. *Eur J Clin Nutr.* Apr 2000;54(4):281-287.
55. Ard JD, Desmond RA, Allison DB, Conway JM. Dietary restraint and disinhibition do not affect accuracy of 24-hour recall in a multiethnic population. *J Am Diet Assoc.* Mar 2006;106(3):434-437.
56. Taren DL, Tobar M, Hill A, et al. The association of energy intake bias with psychological scores of women. *Eur J Clin Nutr.* Jul 1999;53(7):570-578.
57. Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *J Consult Psychol.* Aug 1960;24:349-354.
58. Reynolds WM. Development of Reliable and Valid Short Forms of the Marlowe-Crowne Social Desirability Scale. *Journal of Clinical Psychology.* 1982;38(1):119-125.
59. Novotny JA, Rumpler WV, Riddick H, et al. Personality characteristics as predictors of underreporting of energy intake on 24-hour dietary recall interviews. *J Am Diet Assoc.* Sep 2003;103(9):1146-1151.
60. Scagliusi FB, Polacow VO, Artioli GG, Benatti FB, Lancha AH, Jr. Selective underreporting of energy intake in women: magnitude, determinants, and effect of training. *J Am Diet Assoc.* Oct 2003;103(10):1306-1313.
61. Horner NK, Patterson RE, Neuhouser ML, Lampe JW, Beresford SA, Prentice RL. Participant characteristics associated with errors in self-reported energy intake from the Women's Health Initiative food-frequency questionnaire. *Am J Clin Nutr.* Oct 2002;76(4):766-773.
62. Lafay L, Mennen L, Basdevant A, et al. Does energy intake underreporting involve all kinds of food or only specific food items? Results from the Fleurbaix Laventie Ville Sante (FLVS) study. *Int J Obes Relat Metab Disord.* Nov 2000;24(11):1500-1506.
63. Moreira P, de Almeida MD, Sampaio D. Cognitive restraint is associated with higher intake of vegetables in a sample of university students. *Eat Behav.* Jun 2005;6(3):229-237.

CHAPTER II

MANUSCRIPT

ABSTRACT

Underreporting in dietary assessment has been linked to dietary restraint (DR) and social desirability (SD). Thus, this study investigated accuracy of reporting energy intake (EI) of a laboratory meal during a 24-hour dietary recall (24HR) in 38 healthy, college-aged (20.3 ± 1.7 years), normal-weight women (22.4 ± 1.8 kg/m^2), categorized as high or low in DR and SD.

Participants consumed a meal (sandwich wrap, chips, fruit, and ice cream) and completed a telephone 24HR. Accuracy of reported intake = (((reported intake - measured intake)/measured intake)) x 100 [positive numbers = overreporting].

Overreporting of EI was found in all groups (meal accuracy rate = 43.1 ± 49.9%). An interaction of SD x individual foods ($p < 0.05$) occurred. SD-High as compared to SD-Low more accurately reported EI of chips (19.8 ± 56.2% vs. 117.1 ± 141.3%, $p < 0.05$) and ice cream (17.2 ± 78.2% vs. 71.6 ± 82.7%, $p < 0.05$). An effect of SD occurred, where SD-High as compared to SD-Low more accurately reported meal EI (29.8 ± 48.2% vs. 58.0 ± 48.8%, $p < 0.05$). For measured meal EI, an effect of DR occurred where DR-High consumed less than DR-Low (437 ± 169 kcals vs. 559 ± 207 kcals, $p < 0.05$). An interaction of DR x food type ($p < 0.05$) occurred where DR-High as compared to DR-Low consumed less sandwich wrap (156 ± 63 kcals vs. 210 ± 76 kcals, $p < 0.05$) and ice cream (126 ±73 kcals vs. 190 ± 106 kcals, $p < 0.05$). For reported meal EI, an effect of DR occurred where DR-High reported consuming less than DR-Low (561 ± 200 kcals vs. 818 ± 362 kcals, $p < 0.05$). An interaction of DR x individual foods ($p < 0.05$) occurred where DR-High reported consuming less ice cream than DR-Low (145 ± 91 kcals vs. 302 ± 235 kcals, $p < 0.05$).

Overreporting EI from a laboratory meal was prevalent. However, those high in SD were more accurate in reporting intake, particularly of high-fat foods. Future research is needed to investigate factors that contribute to overreporting.

INTRODUCTION

Assessing dietary intake is an important component of nutrition-focused healthcare, research, and policy development, as it provides information regarding dietary intake that is used for making decisions at the individual and population levels (1-4). For dietary assessment information to be used appropriately, it needs to be accurate and the inherent limitations of assessment methods need to be well understood (3, 5, 6). Many methods have been developed to assess dietary intake, including the food record, food frequency questionnaire, and 24-hour dietary recall (24HR) (3, 4). These frequently used methods of dietary assessment rely on self-reported information, which is subject to potential inaccuracies and biases (1, 5-8). In comparison with other methods, the 24HR has more benefits and fewer limitations when measuring current diet and it is the most frequently used dietary assessment method in national surveillance (3, 4).

Despite its many advantages, when the 24HR is compared to objective measures of energy expenditure, inaccuracies, most commonly due to underreporting, are found (8-10). Many factors have been hypothesized to affect the accuracy of self-reported dietary intake. One factor believed to affect the accuracy of self-reported dietary intake is dietary restraint (DR) (11-16). Individuals who are high in DR, also called restrained eaters (RE), are believed to rely on cognitive controls to limit dietary intake, while those low in DR, also called unrestrained eaters (URE), attend to physiological cues for hunger and satiety (17). The results from several studies have shown that individuals who are high in DR are more likely to underreport dietary intake as compared to those low in DR (11, 13-16). To identify underreporting, the majority of these studies compared reported dietary intake to estimated energy expenditure (11, 14-16). However, not all studies have found an association between DR and the accuracy of reported dietary intake (7, 18, 19). Thus, the conflicting results reveal the need for more research in this area.

Another factor thought to affect the accuracy of reported dietary intake is social desirability (SD) (10, 12), which is a personality characteristic where approval is sought by responding in a socially favorable manner (20). Several studies have found that females who are high in SD are more likely to underreport dietary intake as compared to females who are low in SD (10, 19, 21-23). To identify underreporting, these studies compared reported dietary intake to estimated energy requirements (10, 19, 21-23).

While previous studies have examined the impact of DR or SD singularly on accuracy of reported intake, only one study has examined the influence of the interaction of DR and SD on accuracy of reported intake. In this study, Tooze and colleagues (10) found an interaction between DR and SD in men, such that those high SD were more likely to underreport dietary intake when DR was low. Moreover, no interaction or main effect of DR and SD was found in women. Accuracy of reported energy intake was evaluated by comparing reported energy intake obtained from an average of 2, 24HRs to energy expenditure estimated using the DLW method (10).

The results of these studies show a prevalence of underreporting dietary intake when an individual shows patterns of restrained eating or evidence of high SD. Only one study has examined the influence of both DR and SD on accuracy of reported intake (10). Interestingly, while the investigation by Tooze and colleagues (10) found no interaction of DR and SD related to underreporting in women, previous research in the area of accuracy of self-reported dietary intake suggests a greater prevalence of underreporting among women as compared to men (1, 14, 21). Thus, the purpose of the present study was to evaluate how DR and SD interact to influence the accuracy of reporting consumption of a laboratory meal during a 24HR in normal-weight, college-aged women. It was hypothesized that females categorized as high in both DR and SD would be the least accurate in reporting dietary intake as compared to females categorized as low in DR and SD. As research suggests that individuals high in DR (24) and/or high in SD (22) report consuming less unhealthy foods than individuals low in DR or SD, this study also evaluated how DR and SD influenced accuracy of reporting by food type (healthy and unhealthy foods).

EXPERIMENTAL DESIGN AND METHODOLOGY

Study Design

To examine the influence of DR and SD on accuracy of reported food intake, this study compared actual dietary consumption during a laboratory meal to reported food intake for that meal using a phone 24HR that was collected with Nutrition Data System for Research (NDSR) software version 2007 (NCC, University of Minnesota, Minneapolis, Minnesota). This investigation used a 2 x 2 quasi-experimental design, with 2 between-subject factors: DR (high and low) and SD (high and low). Measured intake, reported intake, and accuracy of reported intake for the laboratory meal were the dependent variables. This study was approved by the Institutional Review Board at The University of Tennessee, Knoxville, Tennessee (UTK).

Participants

Study participants included 38 female students recruited at UTK, using flyers advertising the study as a taste test. Prospective participants contacted the Healthy Eating and Activity Laboratory (HEAL) and an eligibility screening was conducted over the phone. Eligibility was based on the following criteria:

1) Female, between the ages 18-25 years.
2) Normal weight defined as body mass index (BMI) in the range 18.5-24.9 kg/m^2.
3) Categorization of DR based on the score on the restraint factor on the Three Factor Eating Questionnaire –Restraint subscale (TFEQ-R) (25).
    a. High DR (DR-H): $\leq$10
    b. Low DR (DR-L): $\geq$13
4) Categorization of social desirability based on the score on the Marlowe-Crowne Social Desirability Scale Form B (M-C Form B) (26).
    a. High SD (SD-H): $\geq$7
    b. Low SD (SD-L): $\leq$6
5) Participants were excluded if they:
    a. Had participated in another weight loss or exercise research study at UTK.
    b. Were majoring in nutrition or exercise science.
    c. Were unwilling to consume a meal in the laboratory.
    d. Were allergic to, did not like or would not eat the foods served in the laboratory meal.
    e. Smoked.

f. Were pregnant.

g. Had health conditions that influenced eating or required a therapeutic diet.

h. Took medications that influenced eating.

i. Were trying to lose weight.

From September 2008 to August 2009, 163 individuals expressed interested in participating in the study and were phone screened, with 125 not meeting eligibility criteria. Individuals were excluded from the study based on the following reasons: 24 individuals were not interested after learning about the study; 20 individuals were not in the normal BMI range; 9 individuals scored 11 or 12 on the TFEQ-R; 3 individuals exceeded the age range of 18-25 years; 3 individuals were on medications that influence diet; 2 individuals had dietary restrictions or food allergies; 2 individuals had participated in another research study; 1 individual disliked the foods in the meal; 1 individual smoked; and 60 individuals' DR and SD scores placed them in a category that had already met enrollment limit. After the exclusions, 38 participants remained and completed all aspects of the study.

Procedure

After completion of the phone screening, individuals who met the eligibility criteria were asked to select their preferences from a list of choices for each meal component. Participants were scheduled for an individual appointment during the hours of 11:00 am – 3:00 pm on Monday – Thursday. They were instructed to not eat anything for 2 hours prior to the appointment and to taste each of the foods served in the meal.

On the day of the appointment, each food was prepared based on the participant's selections and weighed on an electronic food scale (SI-8001, Denver Instruments, Denver, CO). Upon arrival for their appointment, participants were given instructions on the study content, including a cover story of their participation in a taste test, and were asked to sign an informed consent form. After consenting to the study, height and weight measurements were taken on an electronic scale with stadiometer (Healthometer Professional 597XL, Pelstar LLC, Bridgeview, IL) using standard procedures. The meal was provided to the participant for 30 minutes and verbal instructions were provided to taste each of the foods, eat as much as she wanted, and not take any foods out of the laboratory. Following the meal, participants completed two questionnaires, Food Perceptions and Taste Test Visual Analog Scale (VAS), and provided a mailing address. A telephone 24HR was scheduled with the participant for the following day. Participants were provided written instructions for the 24HR and portion estimation aids, which included a set of measuring cups and spoons and a booklet of diagrams, to be used during the 24HR. After the participant left, the remaining food was weighed. On the day following the laboratory meal, a trained master-level nutrition student called each participant and conducted a multiple-pass 24HR using NDSR. After the 24HR was complete, a $20 gift card was mailed to the participant for compensation.

<u>Foods</u>

The meal consisted of foods that are typically classified as "healthy" and "unhealthy." Each participant was served 2 sandwich wraps, cut in half, cut fresh fruit, chips, ice cream, and water, based on their selections as shown in Appendix A Table 1. The sandwich wrap and fruit were categorized as "healthy" foods and the chips and ice cream were categorized at "unhealthy" foods. Each individual food was prepared and provided according to the participant's selections made during the eligibility screening. The single component foods, including chips, fruit, and ice cream, were provided within 3 grams of the target portion size. For the sandwich wrap, a multiple-component food, each ingredient was provided within 1 gram of the target amount. The meal was served "family-style" with each individual food provided in a separate serving dish. A plate, bowl, and utensil set was provided to the participant for consumption of the meal and participants were allowed to serve themselves any size portion from the provided food.

Measures

Demographics

Demographic information including age, race, and ethnicity was collected from participants during the eligibility phone screen.

Dietary Restraint

The TFEQ-R (25) was used to assess DR for each individual during the eligibility phone screen. It is a widely accepted DR assessment tool and has been shown to identify successful "dieters," those individuals who successfully and consistently reduce their intake, as shown by weight loss and weight loss maintenance (27). The TFEQ-R (25) is a 21-item assessment tool with a point scale range from 0 (no restraint) to 21 (extreme restraint), with 1 point possible for each item. Participants scoring 10 or less were categorized as DR-L and those scoring 13 or greater were categorized as DR-H.

Social Desirability

Social desirability was assessed for each individual using the M-C Form B (26) during the eligibility phone screen. The M-C Form B (26) is a validated, shortened questionnaire, with scores ranging from 0 (low SD) to 12 (high SD), developed from the Marlowe-Crowne Social Desirability Scale (MC-SDS), a 30-item tool. The MC-SDS (20) is a widely accepted tool that measures SD by assessing culturally acceptable behaviors that are unlikely to happen, thus identifying those who seek social favor. Participants scoring 6 or less were categorized as SD-L and those scoring 7 or greater were categorized as SD-H.

Anthropometrics

Height and weight measures were collected during the phone screen and measured during the appointment. Using standard procedures, height was measured to the nearest 1/8 inch and weight was measured to the nearest 0.1 pound (lb) using an electronic scale with stadiometer (Healthometer Professional 597XL, Pelstar LLC, Bridgeview, IL). Height and weight measures were used to calculate BMI as weight (kg)/height $(m)^2$.

Healthfulness of Foods

Following consumption of the meal, each participant completed a Food Perceptions questionnaire where they categorized each food as "healthy" or "unhealthy."

Liking of Foods

As participants were informed that the study was a taste test, following consumption of the meal, participants were asked to rate their liking of each food in the laboratory meal using a 100 mm visual analogue scale (VAS), anchored on the left with "extremely dislike" and on the right with "extremely like."

Measured Dietary Intake

Each individual food was weighed before and after the meal on an electronic food scale (SI-8001, Denver Instruments, Denver, CO). Actual intake during the laboratory meal was calculated by subtracting the weight of each food remaining after the meal from the beginning weight of each food. Each participant's meal, including each individual food and the amount consumed, was entered into NDSR. Measures of gram intake for overall meal and food type (healthy and unhealthy) were determined from actual weighed intake, while energy (kcals) and percent energy from each macronutrient consumed were calculated from NDSR based upon weight of the individual food consumed. Measures of gram intake for each individual food were determined from actual weighed intake, while energy (kcals) was calculated from NDSR based upon weight of individual food consumed.

Reported Dietary Intake

For each participant, reported dietary intake for the laboratory meal was obtained from a multiple-pass 24HR conducted over the phone on the day following the laboratory meal by a master-level nutrition student using NDSR. For overall meal and food type (healthy and unhealthy) reportedly consumed, amount (g), energy (kcals), and percent energy from each macronutrient were calculated using NDSR. For each individual food reportedly consumed, amount (g) and energy (kcals) were calculated using NDSR.

Accuracy of Reported Dietary Intake

Accuracy of reported dietary intake of the laboratory meal was calculated using the equation ((reported intake-measured intake)/measured intake) x 100. Positive numbers indicated overreporting and negative numbers indicated underreporting. Accuracy of reported intake for overall meal and food type (healthy and unhealthy) were calculated for each dietary variable (amount (g), energy (kcals), and energy from each macronutrient (%)). Accuracy of reported intake for each individual food was calculated for amount (g) and energy (kcals).

Statistical Analyses

Baseline characteristics were analyzed with 2-way analysis of variance (ANOVA), using the between-subject factors of DR (high and low) and SD (high and low) for numerical measures and chi-square for nominal measures. Body mass index was found to be statistically different between the groups and thus was included as a co-variable in subsequent analyses.

Measured intake, reported intake, and accuracy of reported intake of the overall meal were analyzed using 2-way analysis of co-variance (ANCOVA), with the between-subject factors of DR (high and low) and SD (high and low). Measured intake, reported intake, and accuracy of reported intake of food types (healthy and unhealthy) were analyzed using 2x2x2 mixed factor ANCOVA, with between-subject factors of DR (high and low) and SD (high and low), and the within-subject factor of food type (healthy and unhealthy). Measured intake, reported intake, and accuracy of reported intake of individual food were analyzed using 2x2x4 mixed factor ANCOVA, with the between-subject factors of DR (high and low) and SD (high and low), and the within-subject factor of individual food (sandwich wrap, chips, fruit, and ice cream). Where appropriate, Greenhouse-Geiser probability levels were used to control for sphericity in the mixed-factor ANCOVAs. For significant outcomes, post-hoc comparisons with Bonferroni corrections were conducted. All analyzes were performed using SPSS Statistics 17.0 (28). The alpha level was set at $p < 0.05$.

RESULTS

Participant Characteristics

Baseline characteristics of participants are shown in Appendix A Table 2. The participants were predominantly white (71%), non-Hispanic (95%), and had a mean age of 20.3 ± 1.7 years. There were no significant ($p > 0.05$) differences between the groups in race, ethnicity, or age. For BMI, there was a significant main effect of DR ($F(1,34) = 7.62$, $p < 0.01$), in which DR-L had a lower BMI (21.7 ± 1.8 kg/m^2) compared to DR-H (23.1 ± 1.4 kg/m^2).

Significant differences in DR and SD scores occurred as expected based upon group categorizations. For DR score, a significant main effect ($F(1,34) = 141.56$, $p < 0.01$) of DR occurred, where DR-L had a lower DR score (5.4 ± 3.1) compared to DR-H (15.0 ± 1.5). For SD score, a significant main effect ($F(1,34) = 156.3$, $p < 0.01$) of SD occurred, where SD-L had a lower SD score (4.5 ± 1.5) compared to SD-H (8.7 ± 1.4). No significant differences ($p > 0.05$) were found in group perceptions of healthy and unhealthy food categorization, including: 97% rated sandwich wrap as healthy; 76% rated chips as unhealthy; 100% rated fruit as healthy; and 84% rate ice cream as unhealthy.

Measured Dietary Intake

Meal

Results for measured intake for the overall meal are shown in Appendix A Table 3. For overall measured intake, no significant ($p > 0.05$) 2-way interaction (DR x SD) or main effects for DR or SD were found for grams consumed of the meal. However, for energy intake, a significant main effect of DR ($F(1,33) = 4.58$, $p < 0.05$) was found, where DR-H consumed less energy (437 ± 169 kcals) compared to DR-L (559 ± 207 kcals). There was no significant ($p > 0.05$) interaction (DR x SD) or main effect of SD for measured energy consumed.

For measured percent energy from fat consumed, a significant main effect of SD ($F(1,33) = 4.68$, $p < 0.05$) occurred, where SD-L consumed a lower percent of energy from fat (27.1 ± 5.0%) as compared to SD-H (30.5 ± 4.9%). No significant ($p > 0.05$) interaction (DR x SD) or main effect of DR was found for measured percent energy from fat consumed.

For measured percent energy from carbohydrate consumed, a significant main effect of SD ($F(1,33) = 6.49$, $p < 0.05$) occurred, where SD-H consumed a lower percent of energy from carbohydrate (55.4 ± 3.8%) compared to SD-L (57.9 ± 2.9%). No significant ($p > 0.05$) interaction (DR x SD) or main effect of DR was found for measured percent energy from carbohydrate consumed.

For measured percent energy consumed from protein, a significant interaction of DR x SD ($F(1,33) = 4.60$, $p < 0.05$) occurred. Pairwise comparisons showed that DR-H/SD-L ate a significantly ($p < 0.1$) lower percent of energy from protein (12.7 ± 2.4%) compared to DR-L/SD-L (16.9 ± 2.9%) with no differences in intake in the other groups. No significant ($p > 0.05$) main effect of SD or DR was found for measured percent energy consumed from protein.

Food Type - Healthy and Unhealthy

Results for measured intake for food type are shown in Appendix A Table 4. For measured gram amount of food type consumed, a significant 3-way interaction ($F(1,33) = 6.60$, $p < 0.05$) occurred. Pairwise comparisons showed DR-L/SD-L consumed significantly ($p < 0.05$) less grams of unhealthy foods (86.4 ± 57.4 g) compared to DR-L/SD-H (132.0 ± 55.0 g), with no differences in intake of healthy foods. Additionally, DR-H/SD-H consumed significantly (p <

0.05) less grams (89.4 ± 47.2 g) of unhealthy foods compared to DR-L/SD-H (132.0 ± 55.0 g), with no differences in intake of healthy foods. Lastly, DR-H/SD-L ate significantly ($p < 0.05$) less grams (266.0 ± 92.2 g) of healthy foods compared to DR-L/SD-L (391.5 ± 94.0 g), with no differences in intake of unhealthy foods. No significant ($p > 0.05$) 2-way interaction (DR x SD, DR x food type, SD x food type) or main effect of DR, SD, or food type occurred for measured gram amount consumed of food type.

A significant 2-way interaction of SD x food type ($F(1,33) = 5.23$, $p < 0.05$) occurred for measured energy consumed for food type. Pairwise comparisons showed SD-L consumed significantly ($p < 0.05$) less energy (197 ± 123 kcals) from unhealthy foods compared to SD-H (294 ± 146 kcals), with no differences in intake of healthy foods. A significant main effect of DR ($F(1,33) = 4.58$, $p < 0.05$) occurred, where DR-H ate less energy (437 ± 169 kcals) than DR-L (559 ± 207 kcals). No significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, DR x food type) or main effect of SD or food type occurred for measured energy consumed for food type.

For measured percent energy from fat consumed, a significant main effect of food type ($F(1,33) = 4.24$, $p < 0.05$) occurred, where a lower percent of energy from fat was consumed from healthy foods (12.3 ± 3.1%) as compared to unhealthy foods (47.1 ± 3.7%). No significant ($p > 0.05$) 3-way interaction (food type x DR x SD), 2-way interaction (DR x SD, DR x food type, SD x food type), or main effect of DR or SD occurred for measured percent energy from fat consumed for food type. For measured percent energy from carbohydrate consumed, no significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, DR x food type, SD x food type), or main effect of DR, SD, or food type occurred for food type.

For measured percent energy from protein consumed, a significant 2-way interaction of DR x food type ($F(1,33) = 7.57$, $p < 0.05$) occurred. Pairwise comparisons revealed DR-H ate a significantly ($p < 0.01$) lower percent of energy from protein (20.9 ± 4.8%) from healthy foods compared to DR-L (24.9 ± 4.2%), with no differences in intake for unhealthy foods. Additionally, a significant main effect of DR ($F(1,33) = 8.54$, $p < 0.01$) occurred, where DR-H ate a lower percent of energy from protein (24.0 ± 35.8%) compared to DR-L (30.4 ± 39.3%). No significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, SD x food type), or main effect of SD or food type occurred for measured percent energy from protein consumed for food type.

Individual Foods

Results for measured intake for individual foods are shown in Appendix A Table 5. No significant ($p > 0.05$) 3-way interaction (DR x SD x foods), 2-way interaction (DR x SD, DR x foods, SD x foods), or main effects of DR, SD, or foods occurred for measured grams of individual foods consumed. A significant 2-way interaction of DR x foods ($F(3,99) = 3.83$, $p < 0.05$) occurred for energy intake of individual foods. Pairwise comparisons showed DR-H ate significantly ($p < 0.05$) less energy (156 ± 63 kcals) from sandwich wrap compared to DR-L (210 ± 76 kcals). Additionally, DR-H ate significantly ($p < 0.05$) less energy (126 ± 73 kcals) from ice cream compared to DR-L (190 ± 106 kcals). A significant main effect of DR ($F(1,33) = 4.58$, $p < 0.05$) was found where DR-H ate less energy (437 ± 169 kcals) than DR-L (559 ± 207 kcals). No significant ($p > 0.05$) 3-way interaction (DR x SD x foods), 2-way interaction (DR x SD, SD x foods), or main effect of SD or foods occurred for measured energy intake of individual foods.

Reported Dietary Intake

Meal

Results for reported intake of the overall meal are shown in Appendix A Table 6. For reported meal gram intake, a significant main effect of DR ($F(1,33) = 4.20$, $p < 0.05$) occurred, where DR-H reported consuming less grams (480.9 ± 180.1 g) of the overall meal compared to DR-L (648.8 ± 261.8 g). No significant ($p > 0.05$) interaction (DR x SD) or main effect of SD occurred for reported gram amount for the overall meal.

For reported meal energy intake, a significant main effect of DR ($F(1,33) = 6.21$, $p < 0.05$) occurred, where DR-H reported consuming less energy (561 ± 200 kcals) from the meal than DR-L (818 ± 362 kcals). No significant ($p > 0.05$) interaction (DR x SD) or main effect for SD occurred for reported energy intake for the overall meal.

For reported percent energy from fat, percent energy from carbohydrate, and percent energy from protein consumed, no significant ($p > 0.05$) interaction (DR x SD) or main effect of DR or SD occurred.

Food Type – Healthy and Unhealthy

Results for reported intake for food type are shown in Appendix A Table 7. A significant 3-way interaction of DR x SD x food type ($F(1,33) = 6.94$, $p < 0.05$) occurred for reported grams of food type consumed. Pairwise comparisons showed DR-H/SD-L reported significantly ($p < 0.05$) less grams (345.2 ± 152.1 g) of healthy foods consumed as compared to DR-L/SD-L (547.7 ± 126.0 g), with no differences in the grams reported for unhealthy foods. Additionally, DR-H/SD-H reported significantly ($p < 0.05$) less grams (80.1 ± 40.9 g) of unhealthy foods consumed as compared to DR-L/SD-H (185.2 ± 104.9 g), with no differences in the grams reported for healthy foods. A significant main effect of DR ($F(1,33) = 4.20$, $p < 0.05$) was found where DR-H reported less grams (480.9 ± 180.1 g) of food eaten as compared to DR-L (648.8 ± 261.8 g). No significant ($p > 0.05$) 2-way interaction (DR x SD, DR x food type, SD x food type) or main effect of SD or food type occurred for reported grams of food type eaten.

A significant 3-way interaction of DR x SD x food type ($F(1,33) = 4.51$, $p < 0.05$) occurred for reported energy consumed for food type. Pairwise comparisons revealed DR-H/SD-L reported significantly ($p < 0.05$) less energy (265 ± 122 kcals) consumed from healthy foods as compared to DR-L/SD-L (449 ± 127 kcals), with no differences in the energy reported for unhealthy foods. Additionally, DR-H/SD-H reported significantly ($p < 0.05$) less energy (224 ± 93 kcals) consumed from unhealthy foods as compared to DR-L/SD-H (461 ± 239 kcals), with no differences in the energy reported for healthy foods. A significant main effect of DR ($F(1,33) = 6.21$, $p < 0.05$) occurred, where DR-H reported consuming less energy (561 ± 200 kcals) compared to DR-L (818 ± 362 kcals). No significant ($p > 0.05$) 2-way interaction (DR x SD, DR x food type, SD x food type) or main effect of SD or food type occurred for reported energy consumed for food type.

For percent energy from fat and percent energy from carbohydrate reportedly consumed, no significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, DR x food type, SD x food type), or main effect of DR, SD, or food type occurred.

For percent energy from protein reportedly consumed, a significant 2-way interaction of DR x food type ($F(1,33) = 5.16$, $p < 0.05$) occurred. Pairwise comparisons showed that DR-H reported significantly ($p < 0.05$) lower percent of energy from protein (26.4 ± 9.8%) eaten from healthy foods as compared to DR-L (34.3 ± 12.1%), with no differences in the percent of energy from protein reported from unhealthy foods. A significant main effect of DR ($F(1,33) = 5.70$, $p < 0.05$) occurred, where DR-H reported a lower percent of energy from protein (17.0 ± 6.7%) consumed as compared to DR-L (20.3 ± 8.0%). No significant 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, SD x food type), or main effect of SD or food type occurred for reported percent energy from protein consumed for food type.

Individual Foods

Results for reported intake for individual foods are shown in Appendix A Table 8. A significant 2-way interaction of DR x foods ($F(3,99) = 3.24$, $p < 0.05$) occurred for reported grams consumed. Pairwise comparisons revealed that DR-H reported eating significantly ($p < 0.05$) less grams (199.0 ± 121.4 g) of sandwich wrap as compared to DR-L (303.3 g ± 151.0). Additionally, DR-H reported eating significantly ($p < 0.05$) less grams (71.1 ± 44.1 g) of ice cream as compared DR-L (143.5 ± 110.1 g). A significant main effect of DR ($F(1,33) = 4.20$, $p < 0.05$) was found where DR-H reported less grams (480.9 g ± 180.1) of foods consumed than DR-L (648.8 ± 261.8 g). No significant ($p > 0.05$) 3-way interaction (DR x SD x foods), 2-way interaction (DR x SD, SD x foods), or main effect of SD or foods occurred for reported grams consumed from individual foods.

A significant 2-way interaction of DR x foods ($F(3,99) = 3.76$, $p < 0.05$) occurred for reported energy consumed for individual foods. Pairwise comparisons showed that DR-H reported significantly ($p > 0.05$) less energy (145 ± 91 kcals) consumed from ice cream as compared to DR-L (302 ± 235 kcals). A significant main effect of DR ($F(1,33) = 6.21$, $p < 0.05$) was found where DR-H reported less energy (561 ± 200 kcals) consumed as compared to DR-L (818 ± 362 kcals). No significant ($p > 0.05$) 3-way interaction (DR x SD x foods), 2-way interaction (DR x SD, SD x foods), or main effect of SD or foods occurred for reported energy consumed for each food.

Accuracy of Reported Dietary Intake

Meal

Results for percent accuracy of reported intake for the overall meal are shown in Appendix A Table 9. The average accuracy rate for reporting the gram amount of the overall meal was 34.0 ± 43.0%, indicating general overreporting in the sample. No significant ($p > 0.05$) interaction (DR x SD) or main effect of DR or SD occurred for accuracy of reported gram intake for the overall meal. The average accuracy rate for reporting energy intake from the overall meal was 43.1 ± 49.9%, indicating general overreporting in the sample. No significant ($p > 0.05$) interaction (DR x SD) or main effect of DR or SD occurred for accuracy of reported energy intake for the overall meal.

For accuracy of reported percent energy from fat, percent energy from carbohydrate, and percent energy from protein, no significant ($p > 0.05$) interaction (DR x SD) or main effect of DR or SD occurred for the overall meal.

Food Type – Healthy and Unhealthy

Results for percent accuracy of reported intake for food type are shown in Appendix A Table 10. The average accuracy rate for reporting the gram amount was of 31.9 ± 43.7% for healthy food and 46.6 ± 78.4% for unhealthy food, indicating general overreporting in the sample. A significant main effect of SD ($F(1,33) = 5.69$, $p < 0.5$) occurred, where SD-L less accurately reported grams of intake (45.0 ± 43.1%) as compared to SD-H (24.1 ± 41.6%). No significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, DR x food type, SD x food type), or main effect of DR or food type occurred for accuracy of intake for reported grams of food type.

The average accuracy rate for reporting energy intake from healthy food was 43.8 ± 57.7% and unhealthy foods was 47.8 ± 76.7%, indicating general overreporting in the sample. No significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, DR x food type, SD x food type), or main effect of DR or food type occurred for accuracy of reported energy intake of food type.

For accuracy of reported percent energy from fat, percent energy from carbohydrate, and percent energy from protein, no significant ($p > 0.05$) 3-way interaction (DR x SD x food type), 2-way interaction (DR x SD, DR x food type, SD x food type), or main effect of DR, SD, or food type occurred.

Individual Foods

Results for percent accuracy of reported intake for individual foods are shown in Appendix A Table 11. Average grams consumed of individual foods was overreported as shown by the average accuracy rate of each food including: 46.5 ± 61.6% for sandwich wrap; 65.9 ± 115.0% for chips; 30.1 ± 74.6% for fruit; and 43.5 ± 83.7% for ice cream. A significant 2-way interaction of SD x foods ($F(3,99) = 3.29$, $p < 0.05$) occurred for accuracy in reporting gram amounts of individual foods. Pairwise comparisons revealed that SD-L were significantly ($p > 0.0$) less accurate in reporting grams chips consumed (117.1 ± 141.3%) as compared to SD-H (19.8 ± 56.2%). In addition, SD-L were significantly ($p < 0.05$) less accurate in reporting grams of ice cream consumed (72.8 ± 81.7%) as compared to SD-H (17.2 ± 78.2%). A significant main effect of SD ($F(1,33) = 6.45$, $p < 0.05$) occurred, where SD-L were less accurate in reporting grams (45.0 ± 43.1%) of foods as compared to SD-H (24.1 ± 41.6%). No significant ($p > 0.05$) 3-way interaction (DR x SD x foods), 2-way interaction (DR x SD, DR x foods) or main effect of DR or foods occurred for the accuracy of reported grams of intake of individual foods.

Average energy intake of individual foods was overreported as shown by the average accuracy rate of each food including: 56.2 ± 73.9% for sandwich wrap; 65.9 ± 115.0% for chips; 28.7 ± 67.7% for fruit; and 43.0 ± 83.9% for ice cream. A significant 2-way interaction of SD x foods ($F(3,99) = 3.19$, $p < 0.05$) occurred for accuracy of reporting energy intake. Pairwise comparisons revealed SD-L were significantly ($p > 0.05$) less accurate in reported reporting energy intake from chips (117.1 ± 141.3%) as compared to SD-H (19.8 ± 56.2%). Additionally, SD-L were significantly ($p < 0.05$) less accurate in reporting energy intake from ice cream (71.6 ± 82.7%) as compared to SD-H (17.2 ± 78.2%). A significant main effect of SD ($F(1,33) = 5.51$, $p < 0.05$) occurred, where SD-L less accurately reported energy intake (58.0 ± 48.8%) compared to SD-H (29.8 ± 48.2%). No significant ($p > 0.05$) 3-way interaction (DR x SD x foods), 2-way interaction (DR x SD, DR x foods) or main effect for DR or foods occurred for the accuracy of reported energy intake for individual foods.

DISCUSSION

The purpose of this study was to evaluate the influence of DR and SD on the accuracy of intake of a laboratory meal reported during a 24HR in college-aged, normal-weight females. It was hypothesized that females categorized as high in both DR and SD would be the least accurate in reporting dietary intake in a laboratory meal. Additionally, this study evaluated how

DR and SD influence accuracy of reporting intake by food type (healthy and unhealthy foods). As a whole, the degree of accuracy in reporting consumption in the laboratory meal was poor as the mean accuracy rate for the overall meal was 34.0 ± 43.0% and 43.1 ± 49.9% for gram and energy intake, respectively, and overreporting occurred in all groups. In analysis of the overall meal, results found no effect of DR or SD on reporting accuracy for grams or energy consumed. For analysis of food type, a main effect of SD occurred where those high in SD were more accurate in reporting grams of food consumed than those low in SD. For analysis of individual foods, a main effect of SD and an interaction of SD with certain foods were found where those high in SD were more accurate in reporting both grams and energy consumed than those low in SD. No differences between the groups were found for reporting accuracy for percent energy consumed from the macronutrients for the overall meal or food type.

This study found a prevalence of overreporting in all groups. In contrast, previous studies, whether DR or SD was evaluated or not, have shown a prevalence of underreporting when reported intake was compared to estimated energy expenditure (8-11, 14-16, 19, 21-23). However, contrary to this, some studies investigating accuracy of reported intake have found overreporting (18, 21, 22, 29, 30). Interestingly, several of the studies documenting overreporting used similar methodology to the current investigation, in which self-reported intake was compared to actual measured intake (18, 29, 30). For example, a study by Ard and colleagues (18) evaluated actual intake for all meals consumed in a laboratory setting for 1 day compared to reported intake obtained from a 24HR and found overreporting of 9.3 % to 11.7% in women. A study by Conway and colleagues (29) evaluated the effectiveness of the AMPM 24HR by comparing reported intake to actual intake measured before and after meals and found that normal weight and overweight women significantly overreported their intake by 9%. Godwin and colleagues (30) evaluated reporting accuracy by comparing actual intake measured before and after meals to intake reported during a 24HR and found overreporting of certain foods, including ice cream, beef, and macaroni and cheese.

One explanation for the prevalence of overreporting found in all groups in this current investigation could be the potential influence of the large portions of foods served to study participants. Each participant was served a meal with 2.5 to 4.5 servings of each food provided "family-style." While participants portioned out foods from serving dishes onto individual dining dishes, the serving dishes remained on the table where the participant consumed the meal. The large portions of foods in the serving dishes could have cued participants to report eating more food than they actually consumed. In contrast to the procedures used in the present study, previous studies that evaluated reporting accuracy of a meal by comparing actual intake to reported intake served food "buffet-style" and provided a separate dining table (18, 29, 30). Another factor that may have contributed to overreporting is weighing participants before they consumed the laboratory meal. This study procedure could have heightened the participant's awareness of their weight, and consequently their eating during the study, potentially influencing study outcomes. Additional research is needed to explore these hypotheses.

In the present study, a relationship between SD and accuracy of reported intake was found. In analysis of food type, an effect of SD occurred where those high in SD were more accurate in reporting grams of intake as compared to those low in SD. In analysis of individual foods, an effect of SD occurred where those high in SD more accurately reported intake of grams and energy as compared to those low in SD. In addition, an interaction occurred where those high in SD more accurate in reporting consumption of grams and energy of chips and ice cream as compared to those low in SD. However, it is important to note that all participants, both high and low in SD, overreported energy intake with the overall accuracy rate for individual foods 29.2 ± 11.7% in SD-H compared to 69.4 ±12.4% in SD-L. Contrary to these findings, previous research found an inverse relationship between SD and accuracy of reported dietary intake in women, where those high in SD were less accurate, with a prevalence of underreporting, as compared to those low in SD (10, 19, 21-23). Differences in methodology in previous research as compared to this investigation could have contributed to the conflicting results. Previous studies compared estimated energy expenditure to reported dietary intake obtained from various dietary assessment methods to evaluate reporting accuracy in individuals ranging from normal weight to obese (10, 19, 21-23). The present study compared actual intake from a laboratory meal to reported intake obtained from a 24HR in normal-weight females. A study with a similar methodology investigating the effect of SD on accuracy of reported intake has not been conducted.

A relationship between DR and accuracy of reporting intake was not found in this investigation. In contrast, previous research has found an inverse relationship between DR and reporting accuracy, with a prevalence of underreporting (11, 13-16). As with the influence of SD on accuracy of reported intake, differences in results may be explained by differences in methodology. Several studies have evaluated accuracy by comparing estimated energy expenditure to reported dietary intake obtained from food records or other non-standard assessment methods (11, 14-16). This study compared reported dietary intake, obtained from a 24HR, to measured intake of meal consumed in a laboratory setting. A few studies have used a similar methodology of comparing reported intake to measured intake, yet even within these studies the results are mixed (13, 18). Ard and colleagues (18) used the most similar methods in a study with 150 men and women where actual intake for all meals consumed in a laboratory setting for 1 day was measured and compared to reported intake obtained using the AMPM 24HR. This study found no relationship between DR and reporting accuracy (18). A study by Jansen (13) also compared measured intake to reported intake in a taste-test setting using a non-standard questionnaire that asked participants to estimate their energy intake of snack foods. This study found an inverse relationship between DR and reporting accuracy (13). While both of these studies measured actual and reported intake, one study evaluated all meals and snacks consumed over a day while the other only evaluated snack foods consumed during a taste test (13, 18). This difference in methodology could have led to the differences in findings.

Two components were used to determine accuracy of reported intake: actual intake and reported intake. In this investigation, when actual intake was examined for the overall meal, by food type, and by individual food, an effect of DR was found, where those high in DR consumed less energy than those low in DR. As restrained eaters are believed to be attempting to reduce their intake using cognitive control (27), the finding that participants high in DR consumed less energy during the laboratory meal agrees with the concept of restrained eating. A study by Rideout and colleagues (31) measured actual dietary intake by weighing foods before and after consumption over a 24-hour period in normal-weight, college women and found that those high in DR consumed less energy compared to those low in DR. The present study confirmed this finding.

Results from this investigation also found that DR influenced the percent energy from protein consumed. For analysis of the overall meal, DR influenced actual intake of percent energy from protein only when SD was low, such that those high in DR consumed a lower percent of energy from protein. For analysis of food type, a main effect was found such that those high in DR consumed a lower percent energy from protein as compared to those low in DR and an interaction was found where those high in DR consumed a lower percent energy from protein from healthy foods as compared to those low in DR. The present findings are in contrast to previous research that has found that those high in DR consume a higher percent of energy from protein as compared to those low in DR (15, 31). One factor that may have contributed to this finding is the difference in protein content of the laboratory meal based on participant's selection of a vegetable and cheese sandwich wrap versus a turkey sandwich wrap. While no significant differences were found between the groups, a higher percent of participants who were high in DR (27.8%) chose the vegetable and cheese wrap as compared to the participants who were low in DR (5.0%), a result approaching statistical significance ($p = 0.055$).

For analysis of individual foods, an effect of DR was found, such that those high in DR consumed less energy from the sandwich wrap and ice cream as compared to those low in DR. A study by Rideout and colleagues (31) that measured actual intake found that restrained eaters consumed less energy from unhealthy foods, those higher in fat and calories, and more energy from healthier foods, those lower in fat and calories. However, this study found mixed results, where those high in DR consumed less of both healthy and unhealthy foods.

For the present study, SD had much less influence on actual intake as compared to the influence of DR. For analysis of the overall meal, those low in SD consumed a lower percent energy from fat as compared to those high in SD and those high in SD consumed a lower percent energy from carbohydrate as compared to those low in SD. For analysis of food type, an interaction of SD and food type was found, where those low in SD consumed less energy from unhealthy foods as compared to those high in SD. These results are in contrast to previous research findings where those high in SD consumed less energy from foods thought to be unhealthy and high in fat, such as sweets or cheese, as compared to those low in SD (22, 32).

For the second component of accuracy, reported intake, results followed patterns similar to the results for measured intake. Results from this investigation for reported intake found that those high in DR reported consuming less grams and energy from the overall meal, by food type, and individual foods as compared to those low in DR. In analysis of food type, a main effect of DR was found such that those high in DR reported consuming a lower percent energy from protein as compared to those low in DR and an interaction occurred such that those high in DR reported consuming a lower percent energy from protein from healthy foods as compared to those low in DR. In analysis of individual foods, an interaction between DR and specific foods occurred such that those high in DR reported consuming fewer grams from the sandwich wrap and fewer grams and less energy from ice cream as compared to those low in DR. These findings are supported by previous research that found that restrained eaters report consuming less energy compared to unrestrained eaters (11, 14, 15, 24). In this study, as reported intake followed the same pattern as actual intake, where those high in DR reported eating less and actually consumed less than those low in DR, accuracy of reported intake was not influenced by DR.

This study has several limitations in the application of the results. The study sample was small with 38 participants. The study sample was predominantly non-Hispanic white, college-aged females with BMI in the normal weight range. While the homogenous study population provides controls for confounding variables, such as age, gender, and weight status, it limits generalizability to other groups of differing characteristics. In addition, the laboratory setting may have altered eating habits and heightened awareness of foods consumed during the meal.

This study found general overreporting of energy intake with an accuracy rate of 43.1 ± 49.9% for the overall meal. When DR and SD were examined, SD was found to influence the accuracy of reported intake from a laboratory meal in colleged-age, normal-weight females. While those high in SD were more accurate as compared to those low in SD, they were still inaccurate and overreported intake. Outcomes may differ from previous research due to variations in study design and methodologies. Future research is needed to investigate factors that contribute to overreporting, such as external cues, portion size estimation, and the influence of the laboratory setting.

REFERENCES

REFERENCES

1. Hill RJ, Davies PS. The validity of self-reported energy intake as determined using the doubly labelled water technique. *Br J Nutr.* Apr 2001;85(4):415-430.
2. Schoeller DA. How accurate is self-reported dietary energy intake? *Nutr Rev.* Oct 1990;48(10):373-379.
3. Gibson RS. *Principles of Nutritional Assessment*. 2nd ed. New York: Oxford University Press; 2005.
4. Thompson FE, Subar AF. Dietary Assessment Methodology. In: Coulston AM, Rock CL, Monsen ER, eds. *Nutrition in the Prevention and Treatment of Disease*. San Diego: Academic Press; 2001:3-30.
5. Beaton GH. Approaches to analysis of dietary data: relationship between planned analyses and choice of methodology. *Am J Clin Nutr.* Jan 1994;59(1 Suppl):253S-261S.
6. Livingstone MB, Black AE. Markers of the validity of reported energy intake. *J Nutr.* Mar 2003;133 Suppl 3:895S-920S.
7. Kretsch MJ, Fong AK, Green MW. Behavioral and body size correlates of energy intake underreporting by obese and normal-weight women. *J Am Diet Assoc.* Mar 1999;99(3):300-306; quiz 307-308.
8. Tran KM, Johnson RK, Soultanakis RP, Matthews DE. In-person vs telephone-administered multiple-pass 24-hour recalls in women: validation with doubly labeled water. *J Am Diet Assoc.* Jul 2000;100(7):777-783.
9. Yanek LR, Moy TF, Raqueno JV, Becker DM. Comparison of the effectiveness of a telephone 24-hour dietary recall method vs an in-person method among urban African-American women. *J Am Diet Assoc.* Oct 2000;100(10):1172-1177; quiz 1155-1176.
10. Tooze JA, Subar AF, Thompson FE, Troiano R, Schatzkin A, Kipnis V. Psychosocial predictors of energy underreporting in a large doubly labeled water study. *Am J Clin Nutr.* May 2004;79(5):795-804.
11. Rennie KL, Siervo M, Jebb SA. Can self-reported dieting and dietary restraint identify underreporters of energy intake in dietary surveys? *J Am Diet Assoc.* Oct 2006;106(10):1667-1672.
12. Maurer J, Taren DL, Teixeira PJ, et al. The psychosocial and behavioral characteristics related to energy misreporting. *Nutr Rev.* Feb 2006;64(2 Pt 1):53-66.
13. Jansen A. How restrained eaters perceive the amount they eat. *Br J Clin Psychol.* Sep 1996;35 (Pt 3):381-392.
14. Asbeck I, Mast M, Bierwag A, Westenhofer J, Acheson KJ, Muller MJ. Severe underreporting of energy intake in normal weight subjects: use of an appropriate standard and relation to restrained eating. *Public Health Nutr.* Oct 2002;5(5):683-690.
15. de Castro JM. Varying levels of food energy self-reporting are associated with between-group, but not within-subject, differences in food intake. *J Nutr.* May 2006;136(5):1382-1388.
16. Lafay L, Basdevant A, Charles MA, et al. Determinants and nature of dietary underreporting in a free-living population: the Fleurbaix Laventie Ville Sante (FLVS) Study. *Int J Obes Relat Metab Disord.* Jul 1997;21(7):567-573.

17. Polivy J, Herman CP. Dieting and binging. A causal analysis. *Am Psychol.* Feb 1985;40(2):193-201.
18. Ard JD, Desmond RA, Allison DB, Conway JM. Dietary restraint and disinhibition do not affect accuracy of 24-hour recall in a multiethnic population. *J Am Diet Assoc.* Mar 2006;106(3):434-437.
19. Taren DL, Tobar M, Hill A, et al. The association of energy intake bias with psychological scores of women. *Eur J Clin Nutr.* Jul 1999;53(7):570-578.
20. Crowne DP, Marlowe D. A new scale of social desirability independent of psychopathology. *J Consult Psychol.* Aug 1960;24:349-354.
21. Novotny JA, Rumpler WV, Riddick H, et al. Personality characteristics as predictors of underreporting of energy intake on 24-hour dietary recall interviews. *J Am Diet Assoc.* Sep 2003;103(9):1146-1151.
22. Scagliusi FB, Polacow VO, Artioli GG, Benatti FB, Lancha AH, Jr. Selective underreporting of energy intake in women: magnitude, determinants, and effect of training. *J Am Diet Assoc.* Oct 2003;103(10):1306-1313.
23. Horner NK, Patterson RE, Neuhouser ML, Lampe JW, Beresford SA, Prentice RL. Participant characteristics associated with errors in self-reported energy intake from the Women's Health Initiative food-frequency questionnaire. *Am J Clin Nutr.* Oct 2002;76(4):766-773.
24. Moreira P, de Almeida MD, Sampaio D. Cognitive restraint is associated with higher intake of vegetables in a sample of university students. *Eat Behav.* Jun 2005;6(3):229-237.
25. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *J Psychosom Res.* 1985;29(1):71-83.
26. Reynolds WM. Development of Reliable and Valid Short Forms of the Marlowe-Crowne Social Desirability Scale. *Journal of Clinical Psychology.* 1982;38(1):119-125.
27. Heatherton TF, Herman CP, Polivy J, King GA, McGree ST. The (mis)measurement of restraint: an analysis of conceptual and psychometric issues. *J Abnorm Psychol.* Feb 1988;97(1):19-28.
28. *SPSS Statistics 17.0* [computer program]. Chicago, IL: SPSS, Inc.; 2009.
29. Conway JM, Ingwersen LA, Vinyard BT, Moshfegh AJ. Effectiveness of the US Department of Agriculture 5-step multiple-pass method in assessing food intake in obese and nonobese women. *Am J Clin Nutr.* May 2003;77(5):1171-1178.
30. Godwin SL, Chambers E, Cleveland L. Accuracy of reporting dietary intake using various portion-size aids in-person and via telephone. *J Am Diet Assoc.* 2004;104(4):585-594.
31. Rideout CA, McLean JA, Barr SI. Women with high scores for cognitive dietary restraint choose foods lower in fat and energy. *J Am Diet Assoc.* Jul 2004;104(7):1154-1157.
32. Lafay L, Mennen L, Basdevant A, et al. Does energy intake underreporting involve all kinds of food or only specific food items? Results from the Fleurbaix Laventie Ville Sante (FLVS) study. *Int J Obes Relat Metab Disord.* Nov 2000;24(11):1500-1506.

APPENDICES

APPENDIX A

RESULTS TABLES

Table 1. Laboratory meal

Item	Target Portion (g)	Average Energy (kcal)
Sandwich wrap (2 provided):		
− Whole wheat flour tortilla	45	120
− Lowfat turkey or vegetable & cheese	50	60
− Lettuce	25	4
− Tomato	50	9
− Fat free Ranch or light Italian dressing	15	20
Berries, melon, or tropical fruit	300	134
Potato chips or tortilla chips	70	364
Chocolate or vanilla ice cream	200	417
Total	940	1341

Note: FOOD CLUB Whole Wheat Flour Tortillas (Topco Associates, Skokie, IL); HILLSHIRE FARM Oven Roasted Turkey Breast (Sara Lee Food and Beverage, Division of Sara Lee Corporation, Downers Grove, IL); KRAFT Singles 2% Milk American (Kraft Foods Global, Inc., Northfield, IL); KRAFT Free Ranch (Kraft Foods Global, Inc., Northfield, IL); KRAFT Light House (Kraft Foods Global, Inc., Northfield, IL); LAY'S Classic Potato Chips (Frito-Lay, Inc., Plano, TX); SANITAS Restaurant Style Tortilla Chips (Frito-Lay, Inc., Plano, TX); BREYERS Chocolate Ice Cream (Unilever, Englewood Cliffs, NJ); BREYERS Vanilla Ice Cream (Unilever, Englewood Cliffs, NJ).

Table 2. Participant characteristics (*M* ± *SD*)

	DR-H/SD-L *n*=8	DR-H/SD-H *n*=10	DR-L/SD-L *n*=10	DR-L/SD-H *n*=10
Age (yrs)	20.9 ± 1.8	19.6 ± 1.6	20.5 ± 1.7	20.2 ± 1.8
BMI (kg/m^2)[1]	23.3 ± 1.5[a]	23.0 ± 1.4[a]	22.1 ± 2.0[b]	21.3 ± 1.6[b]
DR Score[1]	15.3 ± 1.8[a]	14.8 ± 1.2[a]	4.8 ± 3.5[b]	5.9 ± 2.7[b]
SD Score[2]	5.3 ± 1.0[a]	8.0 ± 0.9[b]	3.9 ± 1.6[a]	9.3 ± 1.5[b]
Race (%)				
– Asian	25	0	20	10
– Black/African American	0	0	40	10
– Native Hawaiian/Pacific Islander	0	0	0	10
– White	75	100	40	70
Non-Hispanic/Latino	100	90	100	90
Healthy Foods Ratings (%)				
– Sandwich wrap	88	100	100	100
– Chips	13	20	30	30
– Fruit	100	100	100	100
– Ice cream	13	20	30	0

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; BMI = body mass index; DR = dietary restraint; SD = social desirability. [1]Main effect of DR; [2]Main effect of SD. Values with different superscripts are statistically different ($p < 0.05$).

Table 3. Measured amount, energy, and percent energy from macronutrients consumed in the laboratory meal (*M* ± *SD*)

	DR-H/SD-L *n*=8	DR-H/SD-H *n*=10	DR-L/SD-L *n*=10	DR-L/SD-H *n*=10
Amount (g)	327.7 ± 111.5	441.0 ±109.6	478.0 ± 144.1	463.5 ± 200.6
Energy (kcals)[1]	369 ± 149[a]	492 ± 171[a]	509 ± 197[b]	609 ± 214[b]
Fat (% kcals)[2]	29.2 ± 5.1[a]	29.3 ± 5.2[b]	25.5 ± 4.4[a]	31.7 ± 4.4[b]
CHO (% kcals)[2]	58.1 ± 3.5[a]	56.5 ± 4.1[b]	57.7 ± 2.5[a]	54.2 ± 3.2[b]
Protein (% kcals)[3]	12.7 ± 2.4[a]	14.2 ± 2.6[ab]	16.9 ± 2.9[b]	14.1 ± 3.8[ab]

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; g = grams; kcals = kilocalories; CHO = carbohydrate. [1]Main effect of DR; [2]Main effect of SD; [3]Interaction of DR x SD. Values with different superscripts are statistically different ($p < 0.05$).

Table 4. Measured amount, energy, and percent energy from macronutrients consumed by food type (*M* ± *SD*)

	DR-H/SD-L *n*=8		DR-H/SD-H *n*=10		DR-L/SD-L *n*=10		DR-L/SD-H *n*=10	
	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy
Amount (g)[1]	266.0 ± 92.2^{abcde}	61.7 ± 29.0^{abcdef}	351.6 ± 89.8^{abcdef}	89.4 ± 47.2^{abcef}	391.5 ± 93.9^{abcdf}	86.4 ± 57.4^{acdef}	331.6 ± 161.9^{abcdef}	132.0 ± 55.0^{bdef}
Energy (kcals)[2, 3]	197 ± 72^{abc}	171 ± 91^{ac}	255 ± 99^{abc}	237 ± 128^{bc}	291 ± 63^{abd}	218 ± 145^{ad}	259 ± 106^{abd}	350 ± 147^{bd}
Fat (% kcals)[4]	13.1 ± 4.3^{a}	48.0 ± 4.8^{b}	12.9 ± 2.5^{a}	48.1 ± 3.8^{b}	12.1 ± 3.4^{a}	45.7 ± 3.2^{b}	11.1 ± 2.4^{a}	46.9 ± 3.1^{b}
CHO (% kcals)	68.0 ± 3.6	46.8 ± 4.7	64.9 ± 3.3	46.7 ± 3.7	63.6 ± 2.7	48.7 ± 3.2	63.4 ± 8.3	47.7 ± 2.8
Protein (% kcals)[3,5]	19.0 ± 3.7^{ac}	5.2 ± 0.7^{abc}	22.4 ± 4.2^{ac}	5.3 ± 0.5^{abc}	24.4 ± 3.1^{bd}	5.6 ± 0.4^{abd}	25.5 ± 6.2^{bd}	5.4 ± 0.5^{abd}

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; g = grams; kcals = kilocalories; CHO = carbohydrate. [1]Interaction of DR x SD x food type; [2]Interaction of SD x food type; [3]Main effect of DR; [4]Main effect of food type; [5]Interaction of DR x food type. Values with different superscripts are statistically different ($p < 0.05$).

Table 5. Measured amount and energy consumed from individual foods ($M \pm SD$)

	DR-H/SD-L *n*=8				DR-H/SD-H *n*=10			
	Wrap	Chips	Fruit	Ice Cream	Wrap	Chips	Fruit	Ice Cream
Amount (g)	131.2 ± 55.0	14.3 ± 12.7	134.8 ± 60.6	47.3 ± 22.6	171.3 ± 56.9	16.9 ± 12.0	180.4 ± 56.8	72.5 ± 41.4
Energy (kcals)[1, 2]	133 ± 52^{acde}	75 ± 68^{abcde}	65 ± 35^{abcde}	97 ± 44^{abce}	175 ± 66^{acde}	88 ± 65^{abcde}	80 ± 40^{abcde}	149 ± 85^{abce}

	DR-L/SD-L *n*=10				DR-L/SD-H *n*=10			
	Wrap	Chips	Fruit	Ice Cream	Wrap	Chips	Fruit	Ice Cream
Amount (g)	221.6 ± 63.5	12.6 ± 9.5	170.0 ± 57.5	73.8 ± 50.3	171.2 ± 92.6	23.7 ± 13.6	160.4 ± 100.3	108.2 ± 47.2
Energy (kcals)[1, 2]	225 ± 54^{bcdf}	64 ± 47^{abcdf}	66 ± 23^{abcdf}	154 ± 106^{abdf}	195 ± 94^{bcdf}	123 ± 72^{abcdf}	64 ± 42^{abcdf}	227 ± 98^{abdf}

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; g = grams; kcals = kilocalories.

[1]Interaction of DR x foods; [2]Main effect of DR. Values with different superscripts are statistically different ($p < 0.05$).

Table 6. Reported amount, energy, and percent energy from macronutrients consumed in the laboratory meal ($M \pm SD$)

	DR-H/SD-L *n*=8	DR-H/SD-H *n*=10	DR-L/SD-L *n*=10	DR-L/SD-H *n*=10
Amount (g)[1]	449.5 ± 184.0[a]	506.1 ± 182.6[a]	694.5 ± 229.8[b]	603.1 ± 295.4[b]
Energy (kcal)[1]	541 ± 204[a]	576 ± 205[a]	819 ± 383[b]	818 ± 360[b]
Fat (% kcals)	30.7 ± 5.6	31.2 ± 8.8	27.5 ± 5.1	31.4 ± 5.0
CHO (% kcals)	55.0 ± 4.8	49.8 ± 7.8	50.6 ± 8.4	50.0 ± 6.5
Protein (% kcals)	14.3 ± 4.3	19.1 ± 7.6	21.9 ± 7.6	18.6 ± 8.5

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; g = grams; kcals = kilocalories; CHO = carbohydrate. [1]Main effect of DR. Values with different superscripts are statistically different ($p < 0.05$).

Table 7. Reported amount, energy, and percent energy from macronutrients consumed by food type ($M \pm SD$)

	DR-H/SD-L *n*=8		DR-H/SD-H *n*=10		DR-L/SD-L *n*=10		DR-L/SD-H *n*=10	
	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy
Amount (g)[1, 2]	345.2 ± 152.1^{acde}	104.3 ± 46.4^{abcde}	426.0 ± 181.3^{abcde}	80.1 ± 40.9^{abce}	547.7 ± 126.0^{bcdf}	146.8 ± 127.0^{abcdf}	417.9 ± 225.6^{abcdf}	185.2 ± 104.9^{abdf}
Energy (kcals)[1, 2]	265 ± 122^{acde}	276 ± 105^{abcde}	352 ± 204^{abcde}	224 ± 93^{abce}	449 ± 127^{bcdf}	370 ± 300^{abcdf}	357 ± 210^{abcdf}	461 ± 239^{abdf}
Fat (% kcals)	14.0 ± 5.6	45.4 ± 8.4	17.7 ± 13.0	47.6 ± 5.1	14.5 ± 6.7	45.6 ± 3.5	12.4 ± 3.6	46.2 ± 2.9
CHO (% kcals)	63.3 ± 8.9	48.9 ± 7.0	53.1 ± 12.6	47.4 ± 5.0	51.3 ± 13.1	48.9 ± 3.4	53.4 ± 13.3	48.3 ± 2.9
Protein (% kcals)[2, 3]	22.7 ± 8.4^{ac}	5.7 ± 1.9^{abc}	29.4 ± 10.2^{ac}	5.0 ± 0.5^{abc}	34.3 ± 13.0^{bd}	5.6 ± 0.4^{abd}	34.2 ± 11.9^{bd}	5.6 ± 0.4^{abd}

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; g = grams; kcals = kilocalories; CHO = carbohydrate. [1]Interaction of DR x SD x food type; [2]Main effect of DR; [3]Interaction of DR x food type. Values with different superscripts are statistically different ($p < 0.05$).

Table 8. Reported amount and energy consumed from individual foods (*M* ± *SD*)

	DR-H/SD-L *n*=8				DR-H/SD-H *n*=10			
	Wrap	Chips	Fruit	Ice Cream	Wrap	Chips	Fruit	Ice Cream
Amount (g)[1, 2]	174.3 ± 108.9^{acde}	20.8 ± 12.6^{abcde}	170.9 ± 92.7^{abcde}	83.5 ± 48.2^{abce}	218.7 ± 132.8^{acde}	18.9 ± 7.2^{abcde}	207.2 ± 93.9^{abcde}	61.2 ± 40.2^{abce}
Energy (kcals)[1, 2]	182 ± 108^{abc}	107 ± 65^{abc}	83 ± 52^{abc}	169 ± 101^{ac}	267 ± 189^{abc}	98 ± 37^{abc}	85 ± 31^{abc}	126 ± 82^{ac}

	DR-L/SD-L *n*=10				DR-L/SD-H *n*=10			
	Wrap	Chips	Fruit	Ice Cream	Wrap	Chips	Fruit	Ice Cream
Amount (g)[1, 2]	361.1 ± 96.3^{bcdf}	21.0 ± 21.5^{abcdf}	186.5 ± 71.2^{abcdf}	125.8 ± 121.1^{abdf}	245.5 ± 177.4^{bcdf}	24.0 ± 19.5^{abcdf}	172.4 ± 105.6^{abcdf}	161.2 ± 101.1^{abdf}
Energy (kcals)[1, 2]	372 ± 113^{abd}	105 ± 106^{abd}	77 ± 34^{abd}	265 ± 261^{bd}	291 ± 200^{abd}	122 ± 97^{abd}	66 ± 38^{abd}	339 ± 214^{bd}

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; g = grams; kcals = kilocalories.

[1]Interaction of DR x foods; [2]Main effect of DR. Values with different superscripts are statistically different ($p < 0.05$).

Table 9. Percent accuracy of reported intake amount, energy, and percent energy from macronutrients for laboratory meal ($M \pm SD$)

	DR-H/SD-L *n*=8	DR-H/SD-H *n*=10	DR-L/SD-L *n*=10	DR-L/SD-H *n*=10
Amount (%)	41.7 ± 47.0	16.4 ± 36.7	47.7 ± 42.1	31.8 ± 46.6
Energy (%)	52.3 ± 36.8	24.4 ± 51.8	62.5 ± 58.2	35.1 ± 46.6
Fat (%)	7.0 ± 21.5	6.2 ± 22.2	9.6 ± 22.1	-0.1 ± 16.7
CHO (%)	-5.1 ± 8.6	-11.8 ± 13.0	-12.4 ± 13.1	-7.7 ± 11.4
Protein (%)	12.2 ± 28.5	33.5 ± 39.5	27.6 ± 33.6	33.1 ± 45.9

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; CHO = carbohydrate.

Table 10. Percent accuracy of reported intake amount, energy, and percent energy from macronutrients by food type (*M* ± *SD*)

	DR-H/SD-L *n*=8		DR-H/SD-H *n*=10		DR-L/SD-L *n*=10		DR-L/SD-H *n*=10	
	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy	Healthy	Unhealthy
Amount (%)[1]	34.0 ± 47.2[a]	79.5 ± 65.7[a]	21.6 ± 44.1[b]	-5.9 ± 31.2[b]	44.2 ± 40.8[a]	74.7 ± 84.3[a]	28.1 ± 46.8[b]	44.7 ± 94.6[b]
Energy (%)	36.1 ± 42.8	75.9 ± 53.4	41.2 ± 78.1	2.2 ± 31.8	58.7 ± 57.1	78.3 ± 91.9	37.7 ± 50.6	40.5 ± 91.7
Fat (%)	10.2 ± 34.7	-5.2 ± 15.0	27.8 ± 65.3	-1.1 ± 5.0	24.6 ± 65.3	-0.4 ± 2.6	12.7 ± 28.5	-1.5 ± 2.8
CHO (%)	-6.7 ± 13.2	4.7 ± 13.8	-18.1 ± 19.2	1.5 ± 5.3	-19.6 ± 19.8	0.5 ± 2.8	-16.0 ± 17.7	1.2 ± 2.8
Protein (%)	16.8 ± 32.2	8.4 ± 24.2	30.0 ± 29.9	-4.8 ± 7.2	36.4 ± 41.9	-0.9 ± 4.2	36.2 ± 38.0	3.6 ± 6.5

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high; CHO = carbohydrate.

[1]Main effect of SD. Values with different superscripts are statistically different ($p < 0.05$).

Table 11. Percent accuracy of reported intake amount and energy consumed for individual foods ($M \pm SD$)

	DR-H/SD-L *n*=8				DR-H/SD-H *n*=10			
	Wrap	Chips	Fruit	Ice Cream	Wrap	Chips	Fruit	Ice Cream
Amount (%)[1, 2]	37.8 ± 61.0^{abcde}	103.4 ± 105.2^{acde}	41.3 ± 85.6^{abcde}	76.4 ± 92.8^{abce}	28.1 ± 64.4^{abcdf}	40.3 ± 60.0^{bcdf}	20.8 ± 47.6^{abcdf}	-14.5 ± 33.5^{abdf}
Energy (%)[1, 2]	38.6 ± 58.2^{abcde}	103.4 ± 105.2^{acde}	45.0 ± 87.7^{abcde}	73.7 ± 95.0^{abce}	56.0 ± 105.6^{abcdf}	40.3 ± 60.0^{bcdf}	22.8 ± 52.0^{abcdf}	-14.5 ± 33.5^{abdf}

	DR-L/SD-L *n*=10				DR-L/SD-H *n*=10			
	Wrap	Chips	Fruit	Ice Cream	Wrap	Chips	Fruit	Ice Cream
Amount (%)[1, 2]	67.4 ± 45.7^{abcde}	128.0 ± 169.8^{acde}	14.2 ± 38.8^{abcde}	70.0 ± 76.7^{abce}	51.1 ± 74.2^{abcdf}	-0.7 ± 46.2^{bcdf}	46.5 ± 112.3^{abcdf}	48.9 ± 97.8^{abdf}
Energy (%)[1, 2]	70.6 ± 63.3^{abcde}	128.0 ± 169.8^{acde}	23.4 ± 53.9^{abcde}	70.0 ± 76.7^{abce}	56.1 ± 64.4^{abcdf}	-0.7 ± 46.2^{bcdf}	27.0 ± 83.3^{abcdf}	48.9 ± 97.8^{abdf}

Note: DR-H = dietary restraint–high; DR-L = dietary restraint-low; SD-L = social desirability-low; SD-H=social desirability-high. [1]Interaction of SD x foods; [2]Main effect of SD. Values with different superscripts are statistically different ($p < 0.05$).

APPENDIX B

FLYERS, FORMS, AND QUESTIONNAIRES

Recruitment Flyer 1

Taste Test Study

This study involves a FREE lunch (sandwich wrap, chips, fruit, and ice cream), questionnaires, height and weight measures, and a dietary assessment.

$20 compensation for completion of all study requirements.

Eligibility requirements:

- Female, 18-25 years of age
- Normal weight (BMI 18.5-24.9)
- Willing and able to taste all foods

Excluded individuals:

- Those majoring in Nutrition or Exercise Science
- Individuals who smoke
- Individuals who are pregnant

If interested, please contact Ashlee at the Healthy Eating and Activity Laboratory at 974-0754.

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Recruitment Flyer 2

Are you a healthy eater?

Please come taste-test our lunch!
Taste Test Study involves lunch (sandwich wrap, chips, fruit, and ice cream), questionnaires, height and weight measures, and a dietary interview.

$20 compensation for completion of all study requirements.

Eligibility requirements:

- Female, 18-25 years of age
- Normal weight (BMI 18.5-24.9)
- Willing and able to taste all foods

Excluded individuals:

- Those majoring in Nutrition or Exercise Science
- Individuals who smoke
- Individuals who are pregnant

If interested, please contact Ashlee at the Healthy Eating and Activity Laboratory at 974-0754.

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Taste Test Study Phone Script

Hello, this is ____________ from the Healthy Eating and Activity Laboratory at the University of Tennessee, Knoxville. Thanks for calling about the Taste Test Study. Let me tell you about the study so that you can decide if you are interested in participating. The purpose of the study is to evaluate preferences of females for foods commonly eaten for lunch. This study has two parts, an appointment in our lab and a dietary interview conducted over the phone. Participants in this study will be scheduled for an appointment in our lab to eat a meal and complete questionnaires about the foods. Height and weight measures will also be taken during this appointment. On the day following the meal, participants will be called and asked about the foods eaten on the previous day. The lab appointment should last about 45 minutes and the phone call session should last about 30 minutes. The meal will include a sandwich wrap, lowfat turkey or vegetable and cheese, potato or tortilla chips, fresh fruit, and ice cream. Participants must taste all of the foods in the meal and may eat as much of the foods as she wants. Participants should not eat for 2 hours prior to the scheduled appointment time. Upon completion of the study requirements, including the appointment and the interview, participants will receive $20 mailed to the address of their choice. If you are interested in participating in this study, I have some questions to ask you to determine your initial eligibility. This will take about 20 minutes.

Go to Screening Form.

TASTE TEST STUDY SCREENING FORM

1) Gender: ☐ F ☐ M (**INELIGIBLE**)

2) a) Age:________________ b) Date of birth: ___/___/___ **(must be between 18 and 25)**

If age is not between 18 and 25: I am sorry, but the age range we're recruiting for is 18-25. Since you are _____ yrs old, you are not eligible for this program. Thank you very much for your time.

3) a) Which of the following best describes your racial heritage?(you may choose more than one)

- ☐ American Indian or Alaskan Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or other Pacific islander
- ☐ White
- ☐ Other ________________________________

b) Which of the following best describes your ethnic heritage?

- ☐ Hispanic or Latino
- ☐ Not Hispanic or Latino

4) a) Current weight:_________lbs. b) Height: ____ft ______inches

c) Current BMI:_________ **(must be between 18.5 and 24.9)** BMI= kg/m^2 or (lbs/in^2) x 703

If BMI is below 18.5 or above 24.9: I'm sorry, but because your height and weight are not within the range for this study, you aren't eligible for this program. Thank you very much for your time.

5) Are you majoring in nutrition or exercise science?

☐ No ☐ Yes **(INELIGIBLE)**

If YES to Q5: I am sorry, but this study is not available to individuals majoring in nutrition or exercise science so you are not eligible for this program. Thank you very much for your time.

6) Have you been a participant in a nutrition or exercise research study at the UT?

☐ No

☐ Yes ➔a) What study?_____________________________ **(MAY BE INELIGIBLE)**

b) Did the study involve eating or food?__________ (if **YES, INELIGIBLE**)

If YES to Q6: I am sorry, but due to your participation in another study, you are not eligible for this study. Thank you very much for your time.

7) Are you willing and able to eat the meal in our laboratory as planned for this study? (review meal)

☐ Yes ☐ No **(INELIGIBLE)**

If NO to Q7: I am sorry, but because participation in this study requires that you at least taste all of the foods in the meal served in our lab, you are not eligible for this study. Thank you for your time.

Now I have some health-related questions.

8) Do you smoke or use tobacco products?
☐ No ☐ Yes **(INELIGIBLE)**

If YES to Q8: I am sorry, but due to the fact that you smoke/use tobacco products you are not eligible for this program. Thank you very much for your time.

9) Are you currently pregnant or nursing?
☐ No ☐ Yes **(INELIGIBLE)**

If YES to Q9: I am sorry, but due to the fact that you are currently pregnant/nursing you are not eligible for this program. Thank you very much for your time.

10) Do you have any food allergies or dietary restrictions?
☐ No ☐ Yes → Explain ______________(**INELIGIBLE** if cereal proteins [wheat, rice, gluten], nuts, milk, or egg protein)

If YES to Q10: I am sorry, but due to the fact that you are allergic to __________, you are not eligible for this program because the meal contains __________. Thank you for your time.

11) Do you have a health condition that influences eating or requires a therapeutic diet?
☐ No ☐ Yes **(INELIGIBLE)**

12) Are you currently taking medications for any of the following?

a) Weight loss	☐ No	☐ Yes **(INELIGIBLE)**
b) Attention deficit hyperactivity disorder	☐ No	☐ Yes **(INELIGIBLE)**
c) Depression	☐ No	☐ Yes **(INELIGIBLE)**

If YES to Q11-12: I am sorry, but due to the fact that you have a health condition that influences eating/take _______ medication, you are not eligible for this program. Thank you for your time.

13) Are you currently participating a weight loss program (i.e., Weight Watchers, LA Weight Loss)?
☐ No
☐ Yes, please specify: __________________________ **(INELIGIBLE)**

14) Have you lost weight in the past month?
☐ No
☐ Yes➔ a) How much?_________lbs (If ≥ 5% of body weight (approx 5 lbs)– **INELIGIBLE**)

If YES to any of 13-14: I'm sorry, but because you are currently participating in a weight loss program/lost weight in the last month, you are not eligible for this study. Thank you for your time.

15 a) Please answer true or false to the following statements. (Give bolded answer 1 point.)

			Points
1) When I have eaten my quota of calories, I am usually good about not eating any more.	**T**	F	
2) I deliberately take small helpings as a means of controlling my weight.	**T**	F	
3) Life is too short to worry about dieting.	T	**F**	
4) I have a pretty good idea of the number of calories in common food.	**T**	F	
5) While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it.	**T**	F	
6) I enjoy eating too much to spoil it by counting calories or watching my weight.	T	**F**	
7) I often stop eating when I am not really full as a conscious mean of limiting the amount that I eat.	**T**	F	
8) I consciously hold back at meals in order not to gain weight	**T**	F	
9) I eat anything I want, any time I want.	T	**F**	
10) I count calories as a conscious means of controlling my weight.	**T**	F	
11) I do not eat some foods because they make me fat.	**T**	F	
12) I pay a great deal of attention to changes in my figure.	**T**	F	
Total Points			

15 b) Please answer the following questions with one of the responses that is appropriate for you. (Give bolded answer 1 point.)

	Points
1) How often are you dieting in a conscious effort to control your weight? Rarely Sometimes **Usually** **Always**	
2) Would a weight fluctuation of 5 lbs affect the way you live your life? Not at all Slightly **Moderately** **Very Much**	
3) Do your feelings of guilt about overeating help you to control your food intake? Never Rarely **Often** **Always**	
4) How conscious are you of what you are eating? Not at all Slightly **Moderately** **Extremely**	
5) How frequently do you avoid "stocking up" on tempting foods? Almost never Seldom **Usually** **Almost always**	
6) How likely are you to shop for low calorie foods? Unlikely Slightly unlikely **Moderately likely** **Very likely**	
7) How likely are you to consciously eat slowly in order to cut down on how much you eat? Unlikely Slightly likely **Moderately likely** **Very likely**	
8) How likely are you to consciously eat less than you want? Unlikely Slightly likely **Moderately likely** **Very likely**	
9) On a scale from 0-5, where 0 means no restraint in eating (eating whatever you want, whenever you want) and 5 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself? 0 – eat whatever you want, whenever you want 1 – usually eat whatever you want, whenever you want 2 – often eat whatever you want, whenever you want **3 – often limit food intake, but often "give in"** **4 – usually limit food intake, rarely "give in"** **5 – constantly limiting foods intake, never "giving in"**	
Total Points	

Total Points (15a + 15b):

If Total Points (15a + 15b) = 11 or 12: I'm sorry, based on information you have provided, you are not eligible for this study. Thank you for your interest.

16) Please answer true or false to the following statements. (Give bolded answer 1 point.)

			Points
1) It is sometimes hard for me to go on with my work if I am not encouraged.	T	**F**	
2) I sometimes feel resentful when I don't get my way.	T	**F**	
3) There have been times when I felt like rebelling against people in authority even though I knew they were right.	T	**F**	
4) No matter who I'm talking to, I'm always a good listener.	**T**	F	
5) There have been occasions when I took advantage of someone.	T	**F**	
6) I'm always willing to admit it when I make a mistake.	**T**	F	
7) I sometimes try to get even rather than forgive and forget.	T	**F**	
8) I am always courteous, even to people who are disagreeable.	**T**	F	
9) I have never been irked when people expressed ideas very different from my own.	**T**	F	
10) There have been times when I was quite jealous of the good fortune of others.	T	**F**	
11) I am sometimes irritated by people who ask favors of me.	T	**F**	
12) I have never deliberately said something that hurt someone's feelings.	**T**	F	
Total Points			

(Circle appropriate recruitment box for participant.)

Box B Q15 = 13-21 Q16 = 7-12	**Box A** Q15 = 13-21 Q16 = 1-6
Box C Q15 = 1-10 Q16 = 7-12	**Box D** Q15 = 1-10 Q16 = 1-6

(Is recruitment box is full?)

☐ No
☐ Yes **(INELIGIBLE)**

If recruitment box is full: I'm sorry, based on information you have provided, you are not eligible for this study. Thank you for your interest.

17) Please rate your liking of the foods included in the laboratory meal using a scale 1-5 with 1 means do not like and 5 means like very much.

Sandwich wrap: Turkey or Vegetable & cheese	Chips: Classic potato chips or Tortilla Chips	Fruit Salad: Mixed melon or Mixed berries or Tropical fruit or	Ice Cream: Chocolate or Vanilla
1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

If any food is rated less than 3: I'm sorry, since you do not like _________ (food), you are ineligible for the study. Thank you for your interest.

IF ELIGIBLE: Congratulations! I am happy to tell you that you meet the eligibility criteria for the Taste Test study. I'd like to schedule you for an appointment. We are scheduling appointments Monday-Tuesday, 11:00 am until 2:00 pm.

Which day and time works best for you? (Review schedule for available appointments.)
We have ---- (day), ---- (date) at ---- (time). Does that work for you?

Appointment: M T W R (circle day), ____________ (date) at ____________ (time)

Please select your meal preferences from each category.

Sandwich Wrap:	Condiments:	Chips:	Fruit:	Ice Cream:
☐ Turkey	☐ Fat free Ranch	☐ Potato	☐ Tropical	☐ Chocolate
☐ Vegetable & Cheese	☐ Light Italian	☐ Tortilla	☐ Mixed Berries	☐ Vanilla
	☐ Lettuce		☐ Mixed Melon	
	☐ Tomato			

(Confirm meal selections.)

HEAL is located in the Jessie Harris Building, room 102. Do you know where that is?
(If no, provide directions. JHB is located on Cumberland Ave and 12th Ave, next to the 11th Ave parking garage. The UTK website has a building locator if needed.)

We have you scheduled for ----(day), ---- (date) at ----(time). Your appointment will take about 45 minutes. Please arrive on time as we may have another appointment scheduled immediately after yours. Also, please do not eat for 2 hours prior to your scheduled appointment.

We will send you an email confirming your appointment. If for some reason you cannot keep your appointment please call our lab at 974-0754. Thanks for participating in our study!

First Name: ____________________________ Last Name: ________________________________

Email Address:____

Phone # 1:______________________________ mobile/home/other

Phone # 2:______________________________ mobile/home/other

Eligible: ☐ No ☐ Yes

If No, Reason:__________________________

Appointment Date: ___/___/___ Time: _____

Screened by:______________________________

Date:____________________________________

Recruitment Box (circle one): A B C D

Enter participant information on PTL

INFORMED CONSENT STATEMENT

Taste Test Study

____
Name of Participant

INTRODUCTION

You are invited to participate in a research study. The purpose of this taste test study is to evaluate liking of foods commonly eaten for a lunch meal. Ashlee Schoch is conducting this research study to fulfill requirements of her Master's thesis.

INFORMATION ABOUT PARTICIPANTS' INVOLVEMENT IN THE STUDY

You have been asked to participate in the study because you are female, normal weight, an adult between the ages of 18 and 25, and have no medical conditions, which would indicate that you should not participate in the investigation. A total of 40 people will participate in the study. This study involves two parts. If you choose to participate in this study, you will be asked to complete both parts of the study.

<u>Part 1</u>
For part 1 of this study, you will be asked to attend an appointment in the Healthy Eating and Activity Laboratory (HEAL). During this appointment, height and weight measurements will be taken. You will be asked to eat a meal consisting of a sandwich wrap, chips, fruit, and ice cream. Participation in the study requires that you eat some of each food served. Following the meal, you will be asked to complete questionnaires regarding the meal. This appointment will take approximately 45 minutes.

<u>Part 2</u>
For part 2, you will be asked to complete a dietary interview conducted over the telephone on the day following the laboratory appointment. During the interview, you will be asked questions about foods and beverages you have consumed the previous day, including the laboratory meal. The dietary interview will take about 30 minutes.

Please call Ashlee Schoch at (865) 974-0754 if you have any questions about these procedures for the study.

RISKS

The risks of participating in this study are small. If you are allergic to any of the foods served in the meal, you may have allergic reaction. However, the foods used in the investigation are all common foods and all participants are asked about food allergies during the initial eligibility screening process.

BENEFITS

Participants will receive no benefits from participation in this research study.

CONFIDENTIALITY

The information in the study records will be kept confidential. Data will be stored securely in locked filing cabinets and in password-protected electronic files. Data will be made available only to persons conducting the study unless participants specifically give permission in writing to do otherwise. No reference will be made in oral or written reports which could link participants to the study.

COMPENSATION

You will receive $20 after completing all of the study requirements in both parts of the study. Failure to complete both parts of the study will make you ineligible for the $20 compensation.

EMERGENCY MEDICAL TREATMENT

The University of Tennessee does not "automatically" reimburse subjects for medical claims or other compensation. If physical injury is suffered in the course of research, or for more information, please notify the investigator in charge, Ashlee Schoch at 865-974-0754.

CONTACT INFORMATION

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the researcher, Ashlee Schoch, at the Department of Nutrition, Jessie Harris Building Room 229, The University of Tennessee, Knoxville, TN 37996, and 865-974-0754. If you have questions about your rights as a participant, contact the Office of Research Compliance Officer at (865) 974-3466.

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at anytime without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed you data will be returned to you or destroyed.

CONSENT

I have read the above information. I have received a copy of this form. I agree to participate in this study.

Participant's signature ______________________________ Date __________

Investigator's signature _____________________________ Date __________

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

Date: _______________

Participant Contact Information

Name	
Phone	(Home)
	(Cell)
	(Work)
Email	
Address	

Date: ___________________ ID: ____________

Anthropometric Measures

Height: __________ inches

Weight: __________ lb

BMI: __________ kg/m2

ID: ______

DATE ☐☐/☐☐/☐☐
M M D D Y Y

Food Perceptions

For each food item, check the item included in your laboratory meal. Circle either "healthy" or "unhealthy" based on your perception of the food.

Sandwich wrap ☐ Turkey ☐ Vegetable & cheese	Healthy	Unhealthy
Chips ☐ Classic potato chips ☐ Tortilla chips	Healthy	Unhealthy
Fruit ☐ Mixed berries ☐ Mixed melon ☐ Tropical fruit	Healthy	Unhealthy
Ice cream ☐ Chocolate ☐ Vanilla	Healthy	Unhealthy

ID : ________

DATE ☐☐/☐☐/☐☐
M M D D Y Y

Visual Analogue Scales of Foods

On the blank lines provided, please draw an 'X' to indicate how pleasant tasting the following food items are after you sample them.

EXAMPLE: Pasta Salad

|————————X————|

Dislike extremely — Like extremely

Food 1: Sandwich Wrap

|————————————————|

Dislike extremely — Like extremely

Food 2: Fruit

|————————————————|

Dislike extremely — Like extremely

Food 3: Chips

|————————————————|

Dislike extremely — Like extremely

Food 4: Ice Cream

|————————————————|

Dislike extremely — Like extremely

VITA

Ashlee Schoch is originally from Sneads, Florida. She received an Associate of Arts degree in Business Administration from Chipola College, Marianna, Florida and a Bachelor of Arts degree in Accounting from The University of West Florida, Pensacola, Florida. For 12 years, she worked in call center operations with progressive responsibilities in resource planning and quality assurance. In 2004, she embarked on a new career in nutrition, earning a Bachelor of Science degree in Nutrition from The University of Tennessee – Knoxville (UTK) in 2007. During her undergraduate studies, she worked with several professors in the Department of Nutrition, gaining experience in dietary assessment. She continued her studies at UTK, earning a Master of Science in Nutrition with a concentration in Public Health in 2010. Her graduate studies were funded through a Graduate Research Assistantship with Dr. Hollie Raynor and the Healthy Eating and Activity Laboratory. Through this assistantship, she gained valuable experience in behavioral weight loss management. In addition to her academic studies, she completed a dietetic internship at UTK in 2010. Ashlee plans to continue focusing on her interests in chronic disease prevention and management as a Registered Dietitian.