WEIGHT PERCEPTIONS AND ADHERENCE TO WEIGHT CONTROL PRACTICES IN US ADULTS

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By

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ABSTRACT

The current obesity epidemic our society is facing remains at the forefront of the nation's leading public health concerns. An estimated 66% of US adults are considered overweight or obese. Obesity leads to many health implications and is a risk factor for chronic diseases such as cardiovascular disease, diabetes and hypertension. Analysis of 1999-2006 NHANES data demonstrated that middle-aged US adults self-report their height and weight with a relatively high degree of accuracy, but not BMI. Further analyses indicated that females and obese individuals were more likely to underreport their weight. It was also apparent that people realize a dual approach is important for initiating weight loss, but the dietary and physical patterns revealed were not favorable for weight loss. These findings suggest that greater efforts may be necessary in order to properly equip obese individuals with the knowledge, tools and resources that will lead to successful weight loss.

Key Words: weight loss; obesity; physical activity; dietary behaviors

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CHAPTER 1: INTRODUCTION

Background

The current obesity epidemic facing society remains at the forefront of the nation's leading public health concerns. An estimated 66% of US adults are considered overweight or obese. The trends of the past 20 years have revealed significant increases in obesity prevalence most frequently seen in middle-aged adults (1). The health implications and comorbidities associated with obesity are numerous, and at the same time can be prevented. Obesity is a risk factor for chronic diseases such as cardiovascular disease, diabetes and hypertension. In general, overweight and obesity are defined by excess amounts of body fat. The etiology and epidemiology of obesity is complex and is strongly associated with poor dietary habits, lack of exercise and sedentary lifestyles. Weight loss is the ultimate goal for treatment of overweight and obesity, and literature reports that even modest weight losses of ~5 to 10% improves health status and reduces obesity-related risk factors (2-5).

Weight Perception and Weight Accuracy

For individuals attempting weight loss, changes to physical activity and dietary patterns are most common. Identification of the weight loss practices most commonly used by Americans is a step towards understanding what types of activities are associated with successful weight loss. Successful, long-term weight loss and weight maintenance is achieved when the appropriate balance between dietary patterns and physical activity exists (5). Concerns arise when people inaccurately perceive their weight status, and

therefore, may not realize the severity of the risks associated with excess body weight and body fat. Disparities in weight perception are associated with age, gender and race/ethnicity, determinants that can impact actions towards weight loss (6-10).

Population studies focused on examining health and nutrition status frequently use questionnaires and surveys, which require much of the information and data to be self-reported. Accuracy of self-reported health and physical measures relative to obesity, such as height and weight, is expected to have some degree of error. Although, when height and weight measures are inaccurate, calculations used to assess weight status and BMI become inaccurate as well. Research focused on the accuracy of self-reported BMI indicates that height tends to be overestimated while weight tends to be underestimated, which leads to incorrect BMI categorization and ultimately inaccurate obesity prevalence estimates (5;6;11-13).

The significant physical, social and economic impacts obesity has on Americans are tremendous. A better understanding of the behaviors and high-risk populations most strongly linked to obesity may provide direction and framework for prevention and treatment. It is crucial that a shift in lifestyle behaviors occurs so that a person's health becomes a priority not a burden.

Research Questions

1. What is the accuracy of self-reported weight in middle-aged US adults (stratified by gender, perceived health status)?
    a. Correlations between accuracy of self-reported weight, height and BMI to actual values will be assessed from the information provided by the weight history questionnaire and MEC visit.

b. Subjects identified with height, weight and BMI inaccuracies greater than or less than 5% will be categorized as overreporting or underreporting, respectively.

2. What are the most common weight loss practices used by US adults?
    a. Stratified by gender, weight status, accuracy.
    b. Those adults attempting to lose weight will be identified and a further description of the sample will be provided.
    c. Based on the physical activity and weight history questionnaires, frequency and summation of weight loss practices used will be determined.
    d. Dietary intakes will be examined as raw nutrient intakes, energy-adjusted intakes, percent of recommended calorie and macronutrient intakes.
    e. Physical activity levels will be examined to assess frequency and duration of moderate- and vigorous-intensity activities completed in the past 30 days.

List of Definitions

BRFSS	Behavioral Risk Factor Surveillance Survey; an ongoing telephone health survey that assesses health and nutrition status on a statewide basis.
Body Mass Index	An indicator of body mass calculated as weight (kg) divided by height (m) squared.
DASH diet	A dietary approach used to manage hypertension, which emphasizes fruits, vegetables and low-fat dairy products. This diet further emphasizes nuts, fish, low-fat poultry items and whole grains. Food items high in fat, saturated fat and sodium like red meat, sugar-sweetened beverages and sweets should be limited.
Estimated Average Requirement (EAR)	The amount of a nutrient that meets the physiological requirements of half of the healthy population.
NHANES	National Health and Nutrition Examination Survey; a program of studies designed to assess the health and nutritional status of adults and children in the US.
Normal Weight	A range of weight deemed healthy for a given height; a BMI between 18.5-24.9.
Obesity	A range of weight deemed unhealthy for a given height' a BMI greater than or equal to 30.0.
Overweight	A range of weight deemed unhealthy for a given height; a BMI between 25.0 and 29.9.

Underweight	A range of weight deemed unhealthy for a given height; a BMI less than 18.5.
Waist Circumference	A measurement of girth of the waist.

List of Abbreviations

AI	Adequate Intake
BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance Survey
CI	Confidence Interval
DASH	Dietary Approaches to Stop Hypertension
DRI	Dietary Reference Intake
EAR	Estimated Average Requirement
Kcals	Kilocalories (Calories)
MEC	Mobile Examination Center
MPA	Moderate Physical Activity
MVPA	Moderate-to-Vigorous Physical Activity
NHANES	National Health and Nutrition Examination Survey
RDA	Recommended Dietary Allowance
SES	Socioeconomic Status
VPA	Vigorous Physical Activity
WC	Waist Circumference

CHAPTER 2: LITERATURE REVIEW

One of the leading public health concerns the United States has been facing, and continues to face, is the epidemic mediated by overweight and obesity prevalence. Obesity is not only seen on a national level, but a global level as well. An estimated 66% of Americans are overweight or obese (3). Trends from the past 20 years have shown some of the most significant rises in overweight and obesity prevalence, which is demonstrated by the National Health and Nutrition Examination Survey (NHANES).

In addition, between 1999 and 2008 obesity prevalence increased from 27.5% to 32.2% in men and 33.4% to 35.5% in women. Although, data between 2007 and 2008 indicate that obesity trends among women and men may be leveling off (3).

BMI	Category
<18.5	Underweight
18.6-24.9	Normal
25.0-29.9	Overweight
30.0+	Obese (Class I, II, III)

Table 2.1 BMI Classifications for Adults

Clinical Definition of Obesity

Overweight and obesity are clinically defined as body weights deemed unhealthy for a given height, but in general, obesity is defined as excess body fat. The direct measurement of body composition, especially in the non-clinical setting, represents a considerable limitation to obesity assessment. The use of indirect measures, such as body mass index (BMI), which assesses body weight relative to height, is useful because it correlates well with amounts of body fat (2-4)

In addition to BMI for assessment of adiposity, the National Heart, Lung and Blood Institute suggests using the following waist circumference (WC) cutpoints as well: 40 inches (102 cm) for men and 35 inches (88 cm) for women. These cutpoints signify 'central obesity', which increasing research suggests as an equally important direct measure for assessing obesity-related health risks (14). Data comparing trends between mean WC and abdominal obesity from NHANES 1999-2000 and 2003-2004 shows significant increases in mean WC among overweight men and women. Furthermore, because of the relationship that exists between WC and abdominal obesity, it is likely that a combination of BMI and WC may provide a more accurate prediction of obesity-related mortality and morbidity than BMI or WC alone (15).

The use of WC as a measure for assessing obesity is becoming more heavily relied upon due to the association between increased WC and increased abdominal adiposity .The appropriate measurements help identify and assess obesity-related morbidity and mortality. When an individual is classified with an overweight or obese BMI, as well as WC measurements above suggested cut points, disease risk increases significantly (5).

Significant differences exist between obesity prevalence and gender, as well as between ethnic/racial groups. According to the 2007-2008 NHANES data, the combined age-adjusted prevalence of overweight and obesity was 68.0% (95% CI, 66.3%-69.8%)

	Non-Hispanic White	Non-Hispanic Black	Mexican American
Men	31.9%	37.3%	35.9%
Women	33.0%	49.6%	45.1%

Table 2.2: Age-adjusted Adult Obesity Prevalence by Gender & Ethnicity from 2007-2008 NHANES

overall, 72.3% (95% CI, 70.4%-74.1%) among men, and 64.1% (95% CI, 61.3%-66.9%) among women. The age-adjusted obesity prevalence for men and women stratified by race-ethnicity are presented in the table below (3).

Obesity Prevalence Estimates Compared between Gender and Race/Ethnicity

The Behavioral Risk Factor Surveillance Survey (BRFSS) is an ongoing telephone health survey that tracks self-reported health conditions and risk behaviors on a statewide level and provides additional obesity prevalence estimates. A recent study compared obesity estimates between NHANES and BRFSS, and found that BRFSS underestimated prevalence of overweight and obesity by 9.5% and 5.7% between 1999 and 2000, respectively, mainly due in part to differences in data collection technique (14). It is evident that while the percentages between NHANES and BRFSS are different, the trends in prevalence among subgroups are similar and presented in the table below (16).

Current obesity-related statistics allow for examination of trends in obesity rates over time, as well as make predictions for the future. Prior to NHANES adopting a continuous, two-year sampling cycle, NHANES I, II and III were conducted from 1971 to 1974, 1976 to 1980 and 1988 to 1994, respectively.

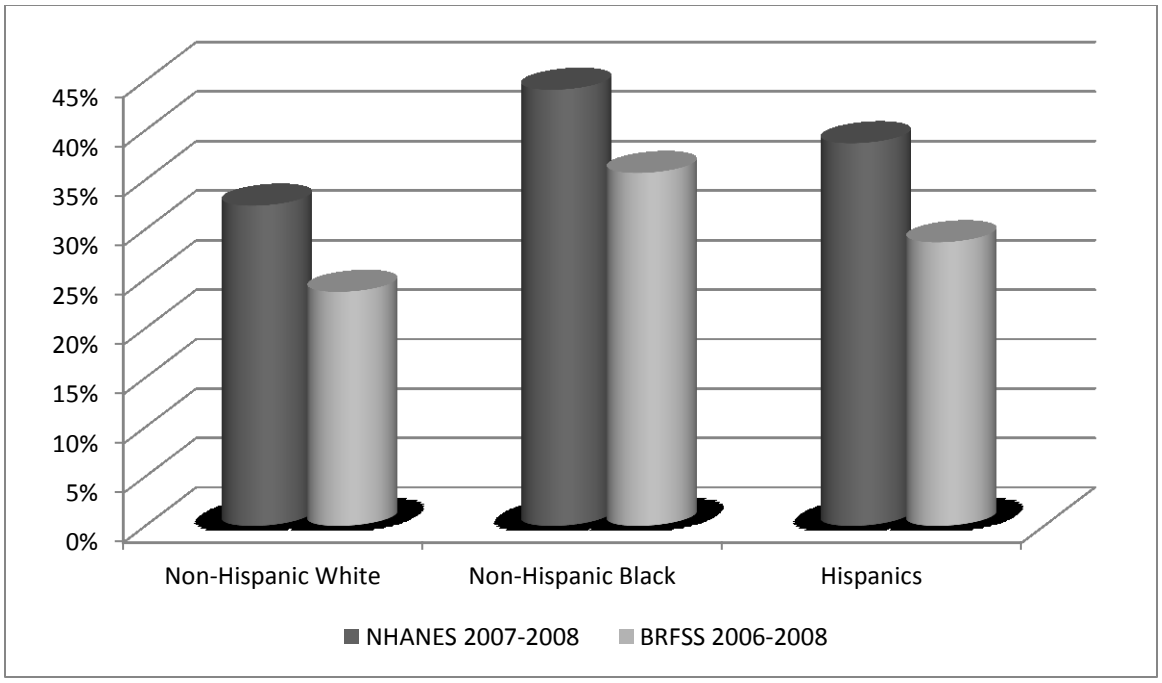

Figure 2.1: Comparison of NHANES and BRFSS Obesity Prevalence Estimates

Increasing obesity rates were evident between NHANES I and II, but it was between NHANES II and III that a significant increase appeared, which was the first glimpse into the nation's obesity epidemic, with an increase in obesity prevalence from 14.5% to 22.5% affecting mainly middle-aged adults and men. Additional increases in age-adjusted overweight and obesity prevalence were found when comparing NHANES II and III: 1.1% increase for non-Hispanic black women and 5.8% increase for Mexican-American men (for class I obesity), as well as 1.8% increase for Mexican-American men and 6.2% increase for non-Hispanic black women (for class II & III obesity). In addition, increases were larger for women compared to men, but the combined age-adjusted obesity prevalence (for class I, II & III obesity) for adults between 20 and 74 years of age increased by 8.0% overall; 7.6% and 8.4% increases for men and women, respectively (1).

Consequences of Obesity

There is an abundance of evidence that exists indicating the health risks associated with overweight and obesity. The comorbidities related to excess body weight and body fat are numerous. A true obesity-related comorbidity should satisfy the following three characteristics: 1) it should increase in frequency and severity with adiposity 2) there should be a plausible explanation for its association with obesity and 3) it should improve or resolve with weight loss. Chronic diseases most commonly linked to obesity are: cardiovascular disease, various cancers, type 2 diabetes, hypertension and dyslipidemia. In addition to health complications, obesity and its related health conditions create an economic burden for all of society (17). The economic costs associated with obesity in the U.S. and Canada is upwards of $300 billion per year including medical care, disability and productivity (18).

Causes of Obesity

In general, obesity occurs when an individual is in *positive energy balance*; energy intake is greater than energy output. A unique and complex interaction exists between both controlled and uncontrolled variables, like genetics, environment, lifestyle and economic determinants that make obesity such a difficult disease to prevent, manage and treat. Lifestyle behaviors, such as dietary and physical activity patterns, contribute greatly to obesity (4;5). Relating back to energy balance concepts.

It takes time for overweight and obesity to take form, which is why long-term, consistent dietary energy overconsumption is an area of concern. Dietary habits are linked to the quantity and quality of foods consumed. Energy-dense foods contain increased amounts of calories in a small volume of food. In contrast, foods with low energy-density contain a small amount of calories for a larger volume of food (4;5;19). Diets consisting largely of energy-dense foods are associated with higher overall energy intakes, which

corresponds to weight gain and possibly overweight and obesity. People tend to opt for unhealthy, energy-dense and nutrient-poor food because it is palatable, convenient and inexpensive (20;21).

Because one gram of fat contains twice as many calories as one gram of either carbohydrate or protein, following low-fat and energy-restricted diets are two weight loss methods that help to reduce the likelihood of weight gain. Fat is the most efficiently stored nutrient because it provides the highest amount of energy, therefore, if the amount of fat consumed in the diet is restricted, it is likely that fewer calories will be consumed and less fat will be stored (19;22;23).

Frequent consumption of high-calorie foods along with physical inactivity is an unfortunate combination, and may be contributing to the struggle of obesity. While most overweight and obese individuals report engaging in physical activity to try to lose weight, the majority of them are not meeting the physical activity guidelines recommendations. Trends indicate that as BMI increases, people are less likely to participate in physical activity (21;24;25). Physical activity not only helps create energy deficits, but also helps increase lean body mass, which can play a significant role in weight loss. The increasing prevalence of sedentary jobs and lack of exercise contributes an additive effect. In a physiological sense, fat is not being expended, thus allowing the body to store the excess energy as fat instead, making overweight and obesity more likely (4;21).

Common Weight Loss Approaches

Weight loss through lifestyle modification is the preferred, first-line of therapy recommended for treatment of overweight and obesity. Dietary and physical activity behaviors are usually the first to be assessed, and consequently adjusted. Successful weight loss is the result of creating a deficit between energy consumed, mainly through food and beverages, and energy expended, through leisure time activities and exercise (5).

Because diet and physical activity are two relatively accessible, simple and affordable weight loss methods, it seems that most people trying to lose weight modify these two variables in one way or another with hopes of adhering to a successful, long-term weight loss regimen. Two qualitative studies examined obese subjects' opinions and views regarding barriers to weight loss intervention adherence. Subjects felt that eating a well-balanced diet is too difficult, lacked the proper nutrition/diet knowledge to eat healthier, were not losing desired amount of weight or lacked self-efficacy and/or motivation for exercising or selecting healthy foods (26;27). As the term 'dieting' is an extremely broad concept, some of the most frequent weight loss methods are energy/calorie restriction, low-fat diets and fad diets (28;29).

Research suggests that successful, long-term weight loss is gradual and is the result of a healthy diet combined with physical activity (5;26). Physical activity as a means for weight loss helps encourage an energy deficit, as well as provide many other health benefits gained from physical activity and improved cardiorespiratory fitness. Physical activity not only takes into account intentional exercise, but daily activities, which also contribute to energy expenditure.

Calorie-/Energy-restricted Diets

Dietary interventions are some of the most common approaches to weight loss. Low-calorie or energy-restricted diets have been linked to significant reductions in body weight, as well as reductions in abdominal adiposity and waist circumference (19;22;30). Moderate energy-restricted diets, those of ~500 kcal reduction/day, which plan for a 0.5 to 1 pound/week gradual weight loss resulted in significant decreases in body weight from baseline to end of intervention (31). Self-monitoring and attention to the amount of energy obtained from foods is one of the best ways to control weight (5;32).

Food group-specific interventions have also been useful for promoting energy deficits. Dietary intervention studies often use the DASH (Dietary Approaches to Stop Hypertension) diet as a foundation because it emphasizes consumption of fruits, vegetables, low-fat dairy products and lean, low-fat protein sources, as well as limiting fat and sodium intakes (19;33;34). Diets similar to the DASH diet aim to encourage healthy foods rather than discourage and restrict unhealthy foods—paralleling recommendations of the Dietary Guidelines for Americans (35). The PREMIER trials, which consist of many studies focused on various lifestyle interventions for reducing and controlling blood pressure in hypertensive individuals, implement DASH-like diet recommendations centered upon low-energy-dense foods (19). One of the more recent PREMIER trials assessed the effects of varying energy-dense diets on weight loss over a 6-month period. The participants who had moderate to high energy density reductions consumed higher total weights of food, fewer calories, and an overall improved diet quality had the most significant weight loss (19).

Incorporating energy restriction into a weight loss regimen is attainable and guides not only successful weight loss, but also successful weight maintenance. For example, in an observational follow-up study, Greene et al. (30) evaluated participants after ≥1 year from completing a weight loss/management program. After an average of 2.2 years post-intervention, 78% and 46% of participants regained less than 5% of their body weight and regained no weight or had continued weight loss, respectively. Long-term weight maintenance was associated with consuming nutrient-rich and low-energy-dense foods. The effectiveness of energy restriction relative to weight loss is further demonstrated in a cross-sectional study that examined the relationship between energy-density of diets to energy intakes and body weight. Ledikwe et al. (22) examined data from the 1994-1996 Continuing Survey of Food Intakes by Individuals and two, 24-hour diet recalls from a

nationally representative sample. Those consuming a less energy-dense diet ate the highest volume/weight of food, in addition to having the lowest prevalence of overweight and obesity as indicated by BMI computed from self-reported height and weight.

Low-fat Diets

Low-fat diets, which usually promote higher fruit, vegetable, low-fat dairy products and lean protein food sources naturally tend to be lower in calories, encouraging weight loss. Although it has been shown that low-fat diets in combination with calorie-/energy-restriction have greater weight loss results than low-fat diets alone, those consuming diets lower in fat tend to consume fewer calories overall, thus maintaining the success of low-fat diets (5).

Howard et al. (34) conducted a prospective randomized controlled trial designed to assess weight changes over a 7-year period relative to the long-term effects of following reduced fat dietary patterns in postmenopausal women participating in the *Women's Health Initiative Dietary Modification Trial*. The women were randomized to either a control group or low-fat diet intervention group, where dietary fat intake was monitored based on a self-reported food frequency questionnaire. In addition, participants were asked to schedule annual clinic visits to provide height, weight and waist circumference measures. With an average age of 62.3 years, those women completing the study did not show significant differences in weight change between the two groups. A significant difference was evident with respect to weight maintenance within 0.5 kg of initial body weight at baseline and end of the study for those in the intervention group compared to the control group. Postmenopausal women maintaining reduced-fat dietary patterns had more success at maintaining weight long-term compared to women continuing with their usual dietary

patterns. While the generalizability of this study's results are limited due to the target population, it seems the continued effectiveness and health benefits related to low-fat diets remains.

In the *Jayhawk Observed Eating Trial*, Donnelly et al. (23) investigated the effects of 3 ad libitum diets with varied dietary fat percentages on weight gain in relatively healthy, yet sedentary overweight and obese men and women. Subjects were randomized to 1 of 3 dietary intervention groups: low fat (LF), <25% of energy from fat; moderate fat (MF), 28-32% of energy from fat; and high fat (HF), >35% of energy from fat. Over a 12-week time period, subjects were provided 2 meals per day during the week and 1 meal per day on the weekend where the quantity and types of foods were controlled and measured using digital photography. Weight change was assessed by changes in measurements taken at baseline, 6 and 12 weeks. No significant changes existed in weight for the LF group, but significant weight gains existed for those in the MF and HF groups; 0.8±2.5 kg and 1.0±2.2 kg, respectively. Diets higher in fat may drive higher energy intake overall, potentially leading to weight gain. Because no significant weight changes were evident among those in the LF group, low-fat dietary patterns may be successful means for weight maintenance.

While the studies described above are limited in scope due to study design, subject selection and applicability of findings, low-fat diets as a method for weight loss remains an effective approach for reducing overall energy intakes, thus helping to guide weight loss and/or prevent weight gain.

Physical Activity

While duration, frequency and intensity of physical activity produce an energy deficit to promote weight loss, adherence to physical activity is highly correlated to weight loss. A multicenter *Weight Loss Maintenance Trial* was conducted between 2003 and 2007 to examine the amount of time overweight and obese participants spent participating in

moderate, vigorous and moderate-to-vigorous physical activity (MVPA). Participants were instructed to wear accelerometers for at least 10 hours per day for 4 days. Of the 82% of participants who wore their accelerometers appropriately, less than 16 minutes/day was spent being active with less than 3 of the 16 minutes being vigorously active., It should be noted that about 50% of study participants had at least 1 bout of MVPA per day, which more often than not exceeded 30 minutes. In addition, the study found shorter durations of total physical activity were associated with older, female, African American and obese participants (36).

Tate et al. (37) conducted a randomized controlled trial where participants were randomized to either a standard behavior therapy (SBT) group or high physical activity (HPA) group with differing calorie expenditure goal levels; 1000 kcal/week and 2500 kcal/week, respectively. After the 18-month intervention, participants in both the SBT and HPA groups showed significant weight loss. At the 30-month post-intervention follow-up, no significant weight loss differences existed between the two groups, which was attributed to the fact that participants found it difficult to maintain the high level of physical activity after the 18 months of guided intervention. Bernstein et al. (38) suggested that while moderately-intense physical activity helps reduce overweight/obesity-related mortality, as well as promote significant weight loss, high-intensity activity might be necessary for more significant weight loss and long-term weight maintenance. An inverse dose-response was evident among both men and women with respect to lower percentages of energy expenditure with high-intensity physical activity and overweight/obesity.

As mentioned previously, physical activity is not only integral for weight loss, but for long-term weight maintenance as well. Two longitudinal, retrospective studies indicated that frequency and intensity of physical activity is inversely related to amount of weight regained over time—those participating in higher intensity and more frequent physical

activity regained less weight (39;40). All of these data support the notion that quality, consistency and adherence to weight loss regimens are difficult especially with respect to diet and physical activity habits.

Physical Activity & Diet Combined

According to the *NHLBI Obesity Guidelines* the most significant reductions in weight resulted when diet and exercise were combined, which is supported by existing research evidence (5). For example, in one of the PREMIER trials, Ledikwe et al. (19) demonstrated that subjects randomized to a DASH-like diet plus at least 180 minutes/week of moderate-intensity physical activity lost significantly more weight when compared to a diet + physical activity 'advice group'; 6.1±0.4 and 1.1±0.2 pounds lost in each group, respectively. The energy deficits resulting from dietary energy restriction and physical activity may have a greater impact on long-term weight loss/maintenance compared to diet or physical activity alone.

Goodpaster et al. (41) completed a randomized controlled study that looked at the effects of moderate-intensity physical activity in conjunction with a low calorie, low-fat diet on weight loss in severely obese men and women. Study participants were randomized to one of two intervention groups: initial-diet and physical activity (for the entire 12-month study duration) or delayed-diet and physical activity (physical activity delayed for first 6 months). Diet and physical activity adherence was monitored using food and exercise logs. Significant differences in weight lost were seen only at 6 months, where the initial-activity group lost an average of 10.9 kg compared to the delayed-activity group that lost 8.2 kg on average. In addition, both groups saw significant improvements in body fat and waist circumference at the 6-month and 12-month mark.

In a similar study, Volpe et al. (42) investigated the effects of diet and exercise alone, and in combination, on body weight, body composition and energy intake in obese,

sedentary men and women. Forty-six pre- or peri-menopausal women and 44 men were randomized to one of three interventions: diet only (D), exercise only (E) and diet and exercise (DE). The study was divided up into three phases, with each phase lasting ~12 weeks. Phases 1 and 2 consisted of nutrition lectures and meetings and supervised physical activity sessions, but during phase 3 the nutrition counseling ended and participants were to exercise at home on their own with provided exercise equipment. The end of phase 3 signified the end of the study duration at 9 months, whereupon participants completed follow-up measurements at the 12-month mark. The results indicated that at 6 months and 9 months, both men and women randomized to the DE group showed significant reductions in body weight that unfortunately were not maintained at the 12-month follow-up.

While much of the literature advocates improvements to dietary and physical activity behaviors as the most effective prescription for successful weight loss, the difficulty for people to maintain adherence to lifestyle changes is very evident.

Additional Weight Loss Practices: Fad Diets, Bariatric Surgery

In addition to the more conventional weight loss practices, like diet and exercise, some of the more unconventional, less evidence-based practices include popular fad diets, meal replacements and bariatric surgery. A disconnect exists between the effectiveness of and adherence to these methods with long-term weight loss. In a 1-year randomized trial, researchers looked at the effectiveness for weight loss and cardiac risk factor reduction, as well as adherence rates for the following 4 popular diets: Atkins, Ornish, Weight Watchers and Zone Diets. Subjects were randomized to 1 of the 4 diet interventions, and significant reductions in body weight resulted in all 4 groups: 2.1±4.8 kg (53%); 3.2±6.0 kg (65%); 3.0±4.9 kg (65%) and 3.3±7.3 kg (50%); respectively, although adherence and compliance issues were reported (43).

Accuracy of Self-reported Data

The continued use of BMI as a measure for overweight and obesity is primarily due in part to cost-effectiveness, availability and ease of use when compared to the other methods available for measuring body fat. Discrepancies exist, although, concerning the usefulness and accuracy of BMI as a measure for determining health and body fat status because it does not take into consideration lean body mass and body fat distribution. In addition, BMI does not differentiate between gender, which means that men and individuals who naturally have higher amounts of lean body mass (i.e. athletes) compared to their normal counterparts, may have an 'overweight' or 'obese' BMI classification when they clearly are not. While other measures of body fat percentage and body fat distribution exist, BMI remains one of the standard ways to assess body fat in adults, especially in the overweight and obese. (5;6;11;13).

Many of the studies carried out that examined data relative to BMI utilized self-reported measures, which over the years has been scrutinized because of associated inaccuracies. Recognizing and accounting for these inaccuracies may help in the application and relevance of BMI as it relates to obesity prevalence. Several studies suggest using adjusted BMI cut-off points or correction equations when analyzing self-reported height and weight, in an effort to minimize the discrepancies between direct and self-reported measures. Variables or indicators most commonly related to inaccurate self-reported BMI are: age, education level, income, race/ethnicity, smoking status, sociodemographic information and physical activity levels. Findings indicated that including variables like those aforementioned allowed for increased accuracy of BMI's and obesity prevalence (12;13).

Literature Findings on Over- and Underreporting

Stommel and Schoenborn (6) examined combined NHANES data between the years 2001 and 2006 to assess the discrepancies between using self-reported versus measured height and weight for calculating BMI and how that is related to the accuracy of BMI classification. While the results revealed misclassifications in all BMI categories, the most misclassifications occurred at the extreme ends of the BMI scale (i.e. underweight and obese), and were usually within a 1-unit interval of the appropriate BMI category. In addition, Dekkers et al. (7) carried out a randomized controlled trial to evaluate the accuracy of self-reported body weight, height and waist circumference among a Dutch overweight working population, with a secondary objective to assess the extent to which participants' measurement accuracy was related to gender, age, overweight status, SES and other health-related factors. The study determined that body weight and height were both significantly inaccurate; weight was under-reported by 1.4 kg and height over-reported by 0.7 cm, respectively, which translated to under-reporting of BMI by 0.7 kg/m^2.

As population studies focused on obesity and its prevalence have continued to address the obesity epidemic, other important factors also related to overweight and obesity have been explored. For instance, ethnic minorities such as African Americans and Mexican Americans tend to be at greater risk for obesity and misclassification of BMI. Furthermore, age and gender are two additional variables linked to BMI inaccuracies. The inaccuracies related to BMI based on self-reported measures may be more deeply rooted within an individual's ability to accurately estimate height and/or weight (8-10).

Two studies looking at racial and ethnic differences related to weight perception versus weight accuracy also looked at gender differences. Both studies gathered and utilized self-reported data from survey questionnaires focused on obtaining information on

height and weight (to calculate BMI), race/ethnicity, gender and weight perception. After statistical analyses, data from these studies showed that women were more likely than men to perceive themselves as overweight (8;9).

Dorsey et al. (10) conducted a cross-sectional study using NHANES data between 1999 and 2006 to examine race and ethnicity trends related to how accurately participants perceive their weight relative to self-reported and direct height and weight measurements. Weight misperception was determined by a comparison of participants' reported weight status ('about the right weight', 'underweight' or 'overweight') to the direct anthropometric measures. Overall, the study concluded that ~40% of underweight and overweight subjects reported believing they were 'about the right weight', as well as ~8% of obese subjects reported being 'about the right weight'. More specifically, 'healthy weight' non-Hispanic blacks were more likely than non-Hispanic whites to consider themselves as 'underweight' (19.1% and 9.0%, respectively), and both non-Hispanic blacks and Mexican-American subjects had a higher prevalence of weight misperception compared to non-Hispanic white 'overweight' and 'obese' counterparts (55.4% & 49.1% vs. 33.9%; and 15.0% and 12.5% vs. 6.0%).

Conclusion

The discrepancies that exist relative to weight perception and weight accuracy in overweight and obese adults provide an important perspective into the prevalence and unfortunate reality that is obesity. It is overwhelming to know that the majority of American adults are considered overweight or obese, in addition to the idea that a significant amount of them do not *perceive* themselves as overweight or obese. The discrepancies are discouraging not only because obesity prevalence rates are slightly inaccurate, but also because those individuals in need of the most help may not seek treatment because they do not perceive their weight as a problem.

As the 20th century and industrialization came to be, people started to live longer, significant improvements in health care and medicine were made, and technological advances occurred. These societal advances have led people to expect 'convenience'. While much of society believes these conveniences help to simplify everyday tasks, many of these conveniences are detrimental to health. For instance, the majority of Americans have sedentary jobs, are dependent on cars/vehicles for transportation, and are 'too busy' to make health a priority. This transition is what some sources refer to as the *nutrition shift* (4). Lifestyle conveniences play a major role in the abundance of unhealthy convenience foods available and inadequate physical activity and insufficient quality, affordable health care—all significant contributors to the nation's obesity epidemic.

CHAPTER 3: METHODOLOGY

Study Overview

Data from the 1999-2006 continuous NHANES were used for the purpose of this study. The data were examined to determine the associations between weight accuracy and weight perception in overweight and obese, middle-aged Americans. NHANES public use files were downloaded, whereupon the data were recoded and transformed to yield data relevant to the current study. This study further aimed to identify the role of dietary and physical activity patterns for those participants attempting to lose weight in a sample population of approximately 10,000 subjects. Data provided by the dietary interviews and physical activity questionnaire was adapted to compare obesity (weight status/BMI) status based on self-reported and measured height and weight, degree of underreporting or overreporting and differences between dietary intake and physical activity patterns. Additional sociodemographic information such as gender and race/ethnicity as also used for assessment.

Research Questions

The analyses from the present study aimed to answer the following:

1. What is the accuracy of self-reported weight in middle-aged US adults (stratified by gender, perceived health status)?
    a. Correlations between accuracy of self-reported weight, height and BMI to actual values will be assessed from the information provided by the weight history questionnaire and MEC visit.

b. Subjects identified with height, weight and BMI inaccuracies greater than or less than 5% will be categorized as overreporting or underreporting, respectively.

2. What are the most common weight loss practices used by US adults?
    a. Stratified by gender, weight status, accuracy.
    b. Those adults attempting to lose weight will be identified and a further description of the sample will be provided.
    c. Based on the physical activity and weight history questionnaires, frequency and summation of weight loss practices used will be determined.
    d. Dietary intakes will be examined as raw nutrient intakes, energy-adjusted intakes, percent of recommended calorie and macronutrient intakes.
    e. Physical activity levels will be examined to assess frequency and duration of moderate- and vigorous-intensity activities completed in the past 30 days.

NHANES Overview

The Centers for Disease Control and Prevention (CDC) has provided the US with health and vital statistics under direction of the National Center for Health Statistics (NCHS). Beginning in 1960, assessment of child and adult health and nutritional status was introduced by the National Health and Nutrition Examination Survey (NHANES), which is a program designed to implement survey studies focused on a variety of health topics. NHANES conducts population studies through in-person health interviews and physical examinations to gather information including medical history, demographics, dietary habits, and physical measurements of health. In 1999, NHANES adopted a continuous 2-year sampling cycle to coordinate with the nation's emerging health concerns.

The primary purpose of NHANES is to monitor and evaluate the nutrition and health status of the U.S. population. This survey allows for examination of trends related to disease

prevalence and associated risk factors. The data collected from NHANES further investigate how those trends relate to variables such as: disease states, environmental exposures, physical fitness, smoking status and dietary patterns as they relate to health. NHANES aims to provide the most current and representative health information and statistics to help build a framework for guidelines on disease prevention, management and treatment to accommodate the nation's changing health needs.

Survey Design

Figure 3.1: Mobile Examination Center

NHANES uses a complex, multi-stage, probability sampling study design. This design allows for subject selection representative of the current civilian, non-institutionalized U.S. population. Each year about 5,000 persons are selected to participate in the survey from 15 different locations. For the data to more accurately represent the U.S. population, under-represented subgroups including low-income, African Americans, Hispanics and individuals 60 years of age or older are over-sampled.

Data Collection

Data collection for NHANES involves an in-home interview, questionnaires and a physical examination performed in a mobile examination center (MEC, Figure 1). Local health and government officials from selected locations are notified about the upcoming survey, upon which eligible households receive a letter introducing the survey and encouraging participation. Prior to the data collection process, households are visited and screened to determine eligibility.

Selected households begin the process by completing an interviewer-assisted in-home questionnaire using Computer-Assisted Personal Interview (CAPI) technology. A hand-held notebook computer device guides the data collection process, which allows the information to be transmitted directly into databases. One to two weeks upon completion of the in-home interview, participants go on to a physical examination taking place in specially-designed MECs, which travel to selected locations throughout the U.S. The examination team consists of a physician, other medical and health professionals, as well as dietary and health interviewers. The MEC design ensures a standardized environment, equipment and specimen collection to control and minimize site-specific errors. Following the physical exam, participants complete additional dietary and health questionnaires guided by CAPI and Audio-Computer-Assisted Self Interview (CASI) technologies, which are followed up with Computer-Assisted Telephone Interview (CATI) and a food frequency questionnaire. Depending on age, the MEC portion of the study on average takes about 3 ½ hours to complete.

Findings from NHANES come from the in-home and dietary intake interviews, MEC physical exam, and questionnaires focused on: demographics, body measures and physical activity.

Demographics

Demographic information such as race/ethnicity, age, household income and education level was collected by CAPI technology used during the in-home interview.

Body Measures

A variety of body measures are recorded during the physical examination portion of the MEC visit. Depending on the participant's age, trained health technicians perform the appropriate measurement protocol with assistance from a recorder. Medical conditions and/or constraints preventing proper body measures to be taken were accounted for. All of

the health technicians were required to attend a 2-day training program where proficiency in anthropometric and measurement techniques were assessed. Pertinent body measures include: standing height in meters, waist circumference in cm and weight in kilograms. MEC examination room environment and setup were standardized to reduce measurement errors. All measurement equipment and tools were properly calibrated and verified by supervisory staff.

Weight History Questionnaire

Guided by CAPI technology during the in-home interview, participants completed a weight history questionnaire, which included items related to self-reported height and weight, personal assessment of current weight status, recent weight loss attempts (within the past 12 months) and methods used for attempting weight loss. In addition, participants are asked to self-report weight history (e.g. 10 years ago, at age 25) and age when weight status was greatest.

Physical Activity Questionnaire

Information gathered from this questionnaire was based off of the Global Physical Activity Questionnaire (GAPQ) and included questions concerning amount of time spent engaging in leisure time activities, daily activities and sedentary activities. Questions attempted to differentiate between intensity of activities (i.e. moderate-to-vigorously intense), in addition to whether completed at work or at leisure. Participants selected which moderately-intense and vigorously-intense activities they performed from a list of examples over the past 30 days. Again, the questionnaire was completed with CAPI technology during the in-home interview.

Dietary Intake Interview

Following the MEC physical examination, dietary interviews were conducted to allow NHANES to gather detailed dietary information and estimate energy intakes of participants. Intakes were assessed on 2 separate occasions—an in-person interview after the physical examination and a telephone interview 3 to 10 days later. Participants were asked to report types and amounts of all individual food and beverage items. Upon completion of the interview participants were asked if the previous 24-hour report was typical or not, and whether or not they were on a special diet.

The first dietary recall involved participants reporting foods and beverages from the previous 24-hour period; midnight to midnight prior to the interview. Then, the second 24-hour dietary recall is conducted over the phone. Data collection was guided by the Automated Multiple Pass Method (AMPM) instrument, a 5-step computerized recall process: quick list, forgotten foods, time and occasion, detail cycle and final probe. The AMPM instrument guides questions based on previous responses. Interviewers administering the dietary interviews were required to complete intensive training, conduct supervised interviews prior to independent practice in the field and were monitored for quality and consistency throughout the data collection period.

Two types of dietary intake data files were generated from the information collected during the interviews, which are called Individual Foods Files and Total Nutrient Intakes files. The Individual Foods Files provide detailed information about individual food types and amounts, and specific nutrients of each food reported. Daily total energy and nutrient intakes from the food items reported are estimated with the Total Nutrient Intakes files. In addition, these data files indentify day of the week the intake occurred, time of eating

occasion, name of eating occasion, amount of food eaten, location where food was consumed, where the food was obtained, energy amounts and 64 nutrients and food components.

After the dietary intakes data files are completed they are sent electronically to the USDA's Food and Nutrient Database for Dietary Studies, 4.1 (FNDDS 4.1), a computer-assisted food coding and data management system. The FNDDS has codes specific to individual foods and reported portion sizes for quick and efficient nutrient intake calculations.

Data Preparation

Data from NHANES 1999-2006 were downloaded from the NCHS website, whereupon the data were recoded and categorized to provide relevant data appropriate for the current study. This involved converting the data found in the NHANES public files into functional research information.

Sample

A nationally representative sample of middle-aged US adults (31-50 years, N=5,759) was used for analysis. Pregnant females during data collection were excluded.

Self-reported and Actual BMI

As part of the weight history questionnaire participants self-reported their current height (in inches) and weight (in pounds). In addition, the questionnaire inquired about self-assessment of weight status and weight perception as participants classified themselves as overweight, underweight or about the right weight. From the self-reported heights and weights, BMI was calculated. Then, self-reported BMI was compared to participants' measured BMI derived from direct height and weight measurements from the MEC visit. Comparisons between the self-reported and measured BMI were used for analysis in this study to examine how accurately participants perceived their weight status.

% of Actual Weight

$$\frac{\boldsymbol{self - reported\ weight}}{\boldsymbol{actual\ weight}} \times \mathbf{100}$$

Categorize Above/Below 5% Over/Underreporting Weight

For participants that self-reported their body weight/BMI status inaccurately, percent of actual body weight was calculated. Weight misclassifications were categorized for participants with differences between self-reported and measured weight greater than or less than 5% as overreporting or underreporting, respectively.

Weight status was determined using measured and self-reported height, weight and BMI. BMI was categorized into 4 classifications: underweight (<18.5 kg/m^2), normal (18.5-24.9 kg/m^2), overweight (25-29.9 kg/m^2), and obese (> 30 kg/m^2).

Sum the Behaviors for Weight Loss

Weight loss practices for those individuals trying to lose weight were self-reported and summated for frequency of use—energy restriction, low-fat diets, physical activity.

% of nutrient need

Nutrient intakes for total energy and macronutrients were assessed.The data was transformed to provide the amount of energy-adjusted nutrients.

Standardization of energy density for the targeted nutrients allowed for nutrient density comparisons among all participants regardless of differences in total energy intake. Energy-adjusted nutrient intakes were per 1,000 kilocalories, and were calculated using the following equation: (total nutrient ÷total kcals) × 1,000.

Compute Physical Activity in Minutes/Week and Times/Week

Physical activity was self-reported by participants during the MEC visit, whereupon they were asked which vigorous activities from a list of examples they performed over the past 30 days. Vigorous activity was defined as those “that caused heavy sweating or large

increases in breathing or heart rate." Corresponding VPA activities were defined as having a metabolic equivalent (MET) level of ≥6.0. Participants were also asked to identify the types of moderate activities they performed in the last 30 days, which were considered activities "that caused light sweating or a slight to moderate increase in your heart rate or breathing." The corresponding MET level for MPA activities was between 3.0 and 5.9. For each of the VPA and MPA activities performed, information regarding the average number of times, frequency and duration (in minutes) over the past 30 days was collected.

Data Analyses

The covariance between self-reported and actual weight and BMI was measured using the Pearson correlation coefficient, indicating the linear strength between the two measures. Chi-Square analyses were used to assess the frequency of underreporting and overreporting of weight and BMI stratified by obesity classification (BMI categories).

After identifying the most commonly used weight loss activities, frequency analyses identified those in the study population attempting to lose weight and thus describe the weight loss practices used most frequently.

For participants that indicated dietary changes for weight loss, nutrient intakes were examined using raw nutrient intakes and energy-adjusted intakes, which were compared for calories and macronutrients. Statistical analyses were done using log-transformed data to improve normality; means and standard errors were analyzed using non-log-transformed data.

Frequencies and duration of moderate, vigorous and total physical activity was computed from the raw data as means and standard errors. This allowed for comparison of physical activity levels related to weight status and attempted weight loss.

SPSS Complex Samples (version 19.0, Chicago, IL) was used for analysis of the NHANES sample. This software allowed for the correction of over-sampling of difficult-to-

reach populations, which resulted in a nationally-representative sample. As the sample was increased to a national size, SPSS Complex Samples also allowed the appropriate standard errors for statistical analyses to be provided.

CHAPTER 4: RESULTS AND DISCUSSION

The purpose of this study was to explore the relationships among weight perceptions, actual weight and compliance to weight loss practices in middle-aged US adults. Demographics and health-related variables were examined to identify the correlates of weight accuracy. Further data analyses were conducted to assess various weight loss practices employed.

	Weight		**Height**		**BMI**	
Groups	**R**	**P**	**R**	**P**	**R**	**P**
Total	0.978	<0.001	0.956	<0.001	0.955	<0.001
Gender						
Male	0.974	<0.001	0.917	<0.001	0.943	<0.001
Female	0.979	<0.001	0.916	<0.001	0.963	<0.001
Weight Status[1]						
Underweight	0.912	<0.001	0.967	<0.001	0.468	0.001
Normal Weight	0.956	<0.001	0.964	<0.001	0.771	<0.001
Overweight	0.956	<0.001	0.940	<0.001	0.555	<0.001
Obese	0.955	<0.001	0.965	<0.001	0.922	<0.001

[1]Based on body mass index from measured weight and height

Table 4.1: Correlations of self-reported height, weight and BMI to measured values by gender and weight status.

What is the Accuracy of Self-reported Weight in Middle-aged US adults?

US adults generally had a high degree of accuracy for self-reported weight (R=0.978, P≤0.001) and height (R=0.956, P=<0.001) compared to measured values (Table 4.1). Females showed a stronger association for accuracy of self-reported weight and BMI compared to males. Despite the strong associations for weight and height, the generation of BMI from self-reported data presented much less agreement compared to measured anthropometric data. There was a strong, positive correlation for self-reported height and weight in both overweight and obese individuals, but a stronger association with calculated BMI was found among obese individuals.

Measure	Variable	Category	>5% under	Accuracy within 5%	>5% over	*P*
Weight	Total		12.2%	79.5%	8.3%	
	Gender	Male	7.6%	80.1%	12.3%	<0.001
		Female	17.0%	78.8%	4.2%	
	BMI categories	Normal weight	6.4%	79.8%	13.8%	<0.001
		Overweight	12.1%	82.3%	5.6%	
		Obese	18.6%	76.9%	4.5%	
Height	Total		0.4%	98.8%	0.8%	
	Gender	Male	0.5%	99.0%	0.6%	0.778
		Female	0.2%	98.7%	1.0%	
	BMI categories	Normal weight	0.1%	99.1%	0.7%	0.117
		Overweight	0.7%	98.9%	0.5%	
		Obese	0.3%	98.5%	1.2%	
BMI	Total		18.2%	71.6%	10.2%	
	Gender	Male	14.4%	73.0%	12.7%	<0.001
		Female	22.1%	70.3%	7.6%	
	BMI categories	Normal weight	9.2%	76.1%	14.7%	<0.001
		Overweight	17.8%	73.8%	8.4%	
		Obese	28.2%	65.5%	6.3%	

Table 4.2: Differences in levels of weight, height and BMI accuracy by gender and obesity status.

Adults were much more likely to have provided an accurate (within 5% of the measured value) estimate of their height (98.8%) compared to estimating their weight (79.5%, Table 4.2). Significant differences were evident among gender and weight status for measured weight and BMI across accuracy categories. Females were significantly more likely to underreport their weight. Furthermore, obese persons were three-times more likely to underreport their weight and BMI compared to normal weight adults, while there was a significantly smaller proportion of overweight adults overreporting their BMI (Table 4.2).

Related literature primarily indicates a poor agreement between self-reported and measured weight; however, the correlations presented herein suggested a stronger association than previously noted. Inaccuracies in self-reported weight are generally seen in all BMI categories, but tend to be more severe in the extreme ends of the scale. The trends most commonly associated with weight accuracy show that women were more likely to underreport their weight, while men were more likely to overreport their height. In addition, overweight and obese individuals have also been shown to inaccurately self-report height and weight compared to normal weight individuals (6-10).

The data indicated a relatively high accuracy for self-reported height and weight, which would make it seem likely that accuracy of self-reported BMI calculated from those measures would be just as high, but this was only the case for obese individuals. The lower proportions for accurately self-reporting BMI demonstrate the sensitivity of BMI to slight inaccuracies in self-reported heights and weights.

Identification of relationships between accuracy of self-reported BMI measures and under-/overreporting may allow health professionals to better target at-risk individuals, groups and/or populations. For example, some studies looked at the effectiveness of adjusting BMI cut-off points or using correction equations with self-reported data for

subgroups susceptible to reporting height and/or weight inaccuracies in an effort to minimize the associated error (12;13). When it is apparent that certain subgroups are more or less likely to accurately estimate weight, height and BMI, then those inaccuracies may be better accounted for.

What are the Most Common Weight Loss Practices Used By US adults?

Nearly one-third of males and over half of females reported trying to lose weight over the past year, while females (OR: 2.26 [2.00-2.56]) were significantly more likely to attempt weight loss (Table 4.3). Overweight individuals (61%) reported the highest percentage of attempting to lose weight. Half of adults who underreported their weight indicated attempting to lose weight, while 23% of those who overreported their weight indicated attempting weight loss (0.69 [0.57,0.83]).

Variable	Group	Trying to lose weight	OR (95% CI)
Total		44%	
Gender	Male	33%	Referent
	Female	54%	2.26 (2.00, 2.56)
Perceived Weight Status	Underweight	4%	0.27 (0.12, 0.59)
	About the right weight	21%	Referent
	Overweight	60%	3.58 (2.96, 4.32)
Weight Accuracy	>5% underestimation	50%	0.82 (0.65, 1.03)
	within 5%	45%	Referent
	>5% overestimation	23%	0.69 (0.57, 0.83)
Weight Status	Normal weight	26%	Referent
	Overweight	46%	1.75 (1.39, 2.21)
	Obese	61%	2.14 (1.69, 2.70)

Table 4.3: Proportion of US Adults who tried to lose weight in past year compared to perceived weight status, weight accuracy and weight status (n=5,759)

Practices to lose weight	Total (n=2352)	Gender		Weight Status		
		Male (n=883)	Female (n=1378)	Normal weight (n=339)	Over weight (n=801)	Obese (n=1118)
Ate less food	64%	60%	67%	65%	64%	64%
Exercised	63%	64%	62%	70%	69%	55%
Ate less fat	43%	40%	44%	41%	43%	42%
Lowered calories	39%	37%	41%	39%	38%	41%
Drank a lot of water	34%	29%	38%	30%	36%	35%
Skipped meals	20%	20%	20%	18%	19%	22%
Ate diet products	14%	10%	16%	12%	16%	13%
Took non-RX suppl.	12%	9%	14%	10%	12%	13%
Followed a special diet	11%	10%	11%	5%	8%	15%
Ate fewer carbohydrates	10%	9%	11%	13%	7%	12%
Used liquid diet formula	10%	7%	12%	10%	11%	10%
Joined program	8%	2%	12%	6%	8%	9%
Took RX diet pills	4%	2%	5%	2%	3%	5%
Other methods	3%	3%	2%	2%	2%	3%
Took laxatives	1%	1%	2%	1%	1%	2%
Started smoking	1%	1%	1%	1%	0%	1%
Changed eating habits	0%	0%	0%	0%	0%	0%
Ate less sugar, candy, sweets	0%	0%	0%	0%	0%	0%
Ate more fruits, vegetables, salads	0%	0%	0%	0%	0%	0%

Continued

Table 4.4: Common weight loss practices for US adults stratified by gender, perceived weight status and weight accuracy

Trends in the data revealed several factors may be involved in weight accuracy and the likelihood to attempt weight loss. The data herein suggest that perceived weight status may be a more powerful predictor compared to weight accuracy relative to attempted weight loss. Previously discussed findings demonstrated a relatively high degree of accuracy between self-reported and measured weight, which in turn suggests a similar degree of accuracy for weight perception.

Related population studies (6;8-10), support the current study's findings that obese individuals are more likely to report weighing less than they actually do, but interestingly

Table 4.4: continued

Practices to lose weight	Perceived Weight Status: Under-weight (n=10)	About right (n=357)	Over-weight (n=1893)	Accuracy of Self-reported Weight: >5% under (n=322)-	within 5% (n=1820)	>5% over (n=119)
Ate less food	53%	62%	65%	65%	65%	57%
Exercised	69%	72%	61%	59%	63%	58%
Ate less fat	48%	44%	42%	39%	43%	38%
Lowered calories	0%	39%	39%	38%	40%	35%
Drank a lot of water	29%	28%	36%	31%	36%	23%
Skipped meals	20%	16%	21%	22%	20%	18%
Ate diet products	9%	10%	14%	8%	15%	8%
Took non-RX suppl.	3%	7%	13%	16%	11%	14%
Followed a special diet	0%	6%	12%	9%	11%	5%
Ate fewer carbohydrates	0%	11%	10%	10%	11%	10%
Used liquid diet formula	13%	8%	11%	9%	10%	10%
Joined program	0%	5%	9%	6%	9%	0%
Took RX diet pills	0%	0%	5%	6%	4%	1%
Other methods	0%	2%	3%	2%	2%	6%
Took laxatives	0%	1%	2%	2%	1%	2%
Started smoking	0%	0%	1%	0%	1%	0%
Changed eating habits	5%	0%	0%	0%	0%	0%
Ate less sugar, candy, sweets	0%	0%	0%	0%	0%	0%
Ate more fruits, vegetables, salads	0%	0%	0%	0%	0%	0%

enough both overreporters and underreporters were less likely to have attempted weight loss compared to those that reported weight within 5%.

For persons attempting to lose weight, the most commonly reported weight loss practices were eating less food (64%), exercising (63%), eating less fat (43%), eating less calories (39%), drinking a lot of water (34%) and skipping meals (20%,Table 4.4). Females reported eating less food, eating less fat, lowering calories and drinking a lot of water more often, whereas males more often reported exercise for weight loss. While exercise remained the second most common weight loss practice for obese individuals, these adults were less likely to exercise than were their normal or overweight counterparts. Similar trends for

Number of strategies	Gender			Weight Status		
	Total	Male	Female	Normal weight	Over-weight	Obese
1	19%	22%	17%	23%	18%	19%
2	20%	21%	20%	20%	23%	19%
3	18%	21%	17%	17%	18%	19%
4	16%	17%	16%	15%	16%	17%
5	11%	10%	12%	12%	11%	11%
6	7%	6%	8%	5%	7%	8%
7	5%	2%	6%	6%	5%	4%
8	3%	1%	4%	3%	3%	3%

Number of strategies	Perceived Weight Status			Self-reported Weight Accuracy		
	Under-weight	About right	Over-weight	>5% under-estimation	within 5%	>5% over-estimation
1	43%	21%	19%	18%	19%	32%
2	8%	22%	20%	25%	19%	22%
3	16%	19%	18%	20%	18%	15%
4	20%	17%	16%	15%	17%	15%
5	13%	12%	11%	9%	12%	6%
6	0%	5%	7%	7%	7%	8%
7	0%	3%	5%	3%	5%	0%
8	0%	1%	3%	3%	3%	4%

Table 4.5: Number of weight loss strategies reported by US adults by gender, perceived weight status and weight accuracy

weight loss practices were correlated with perceived weight status and accuracy of body weight. None of the adults that perceived themselves to be underweight reported lowering their calories to lose weight, following a special diet or eating fewer carbohydrates.

Most (84%) individuals reported using five or fewer weight loss strategies; less than 20% reported a single approach and half reported up to three different strategies. Males compared to females reported higher percentages for using fewer weight loss strategies. In addition, 57% of individuals perceived as overweight compared to 62% that perceived a normal weight status reported using up to three strategies for weight loss. In general, as the

number of weight loss strategies increased, percentages decreased for overreporters, while percentages increased for underreporters (Table 4.5).

Sustained weight loss and weight maintenance primarily result when dietary and physical activity modifications are combined. While the majority of weight loss practices were directed at dietary modifications, those individuals also reported physical activity data. It may be reasonable to speculate that, in general, people understand the combined efforts of diet and exercise are associated with weight loss, although, there may be a lack of knowledge and understanding concerning the degree of dietary and physical activity modifications are required to mediate weight loss.

The US Department of Health and Human Services' 2008 Physical Activity Guidelines for Americans recommends that adults between 18 and 64 years of age engage in 2 hours and 30 minutes a week of moderate-intensity, or 1 hour and 15 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity. Studies indicate that individuals find it difficult to maintain the duration and intensity of physical activity upon completion of weight loss interventions (37;39;40). It becomes evident the challenges many experience with trying to meet the recommended types and amounts of physical activity, in addition to lifestyle barriers that make it difficult to reach these activity goals. Therefore, access to the appropriate health education and resources can help close this knowledge gap.

Mean energy, fat and carbohydrate intakes were not significantly different for those who reported cutting calories, fat and carbohydrates, respectively, to lose weight, compared to those who did not (Table 4.6). For those that indicated dietary modification, there was a modest reduction in the percent of energy from fat and carbohydrate, respectively, if they reported such a modification, while also presenting with higher percentages of energy from

Modification to lose weight	Nutrient intakes	Employed modification to lose weight		
		No	Yes	P
Lowered calories	Energy (kcals)	2216 (34)	2171 (40)	0.414
	Fat (% of energy)	33.9 (0.4)	34.1 (0.5)	
	Carbohydrate (% of energy)	48.4 (0.4)	48.1 (0.6)	
	Protein (% of energy)	15.6 (0.2)	16.3 (0.4)	
Ate less fat	Total Fat (g)	86.1 (1.7)	81.2 (1.8)	0.065
	Fat (% of energy)	34.7 (0.4)	33.1 (0.4)	
	Carbohydrate (% of energy)	47.4 (0.4)	49.3 (0.6)	
	Protein (% of energy)	15.8 (0.2)	16 (0.3)	
Ate fewer carbohydrates	Carbohydrates (g)	264 (4)	245 (10)	0.114
	Fat (% of energy)	33.8 (0.3)	36 (0.7)	
	Carbohydrate (% of energy)	48.8 (0.4)	44 (0.8)	
	Protein (% of energy)	15.7 (0.2)	17.2 (0.5)	
Any Dietary Modification	Energy (kcal)	2219 (77)	2196 (26)	
	Protein (g)	84.2 (3.9)	85 (1.3)	
	Carbohydrate (g)	269 (11)	261 (4)	
	Total fat (g)	83.1 (3.4)	84.1 (1.3)	
	Saturated fatty acids (g)	27.3 (1.3)	27.6 (0.4)	
	Monounsaturated fatty acids (g)	30.7 (1.3)	31.2 (0.5)	
	Polyunsaturated fatty acids (g)	17.2 (0.9)	17.8 (0.3)	
	Fat (% of energy)l	33.2 (0.9)	34.1 (0.3)	
	Carbohydrate (% of energy)	49.8 (1.1)	48.1 (0.4)	
	Protein (% of energy)	15.4 (0.4)	15.9 (0.2)	
	Energy (kcal)	2219 (77)	2196 (26)	
	Protein (g)	84.2 (3.9)	85 (1.3)	

Table 4.6: Macronutrient comparisons for dietary modifiers and non-modifiers

protein. Comparisons between total energy and macronutrient intakes were assessed for individuals who reported 'changes' or 'no changes' to their diet. The difference in mean intakes between dietary modifiers and non-dietary modifiers was 23 kilocalories, 4.9 for grams of fat and 19 for grams of carbohydrates. Overall, those who reported dietary changes had slightly higher percentages of calories from fat and protein (34.1% vs. 33.2% and 15.9% vs. 15.4%; respectively), but a slightly lower percentage of calories from

carbohydrate. Despite reporting dietary modification to lose weight, little difference was seen between the groups. While individuals who indicated eating fewer calories, reducing fat and eating fewer carbohydrates did in fact report lower percentages of each, these differences were not significant.

The data, however, revealed some interesting relationships among macronutrient and energy intakes and dietary modifications. Those who ate less fat to lose weight did in fact consume an overall lower percentage of energy from fat comparatively (33.1% vs. 34.7%), but this percentage still falls short of the American Heart Association's recommendations of <30% of total calories from fat for heart health purposes (44). Studies looking at low-fat diets and weight loss tend to mimic the American Heart Association's recommendations with treatment groups consuming <30% of total calories from fat, which questions whether or not individuals can successfully employ low-fat diets (5;23). Furthermore, persons who ate fewer carbohydrates ended up consuming a higher percentage of total energy from fat. The corresponding shifts in energy and macronutrient intakes is concerning in some ways because there is no differentiation between quantity and quality of food sources. For example, heart-healthy fats and high-quality carbohydrate selections will impact a person's diet differently than higher saturated fat intakes and processed carbohydrates. Research also indicates that calorie-restriction is one of the most successful ways to promote weight loss, although many instances take place under controlled interventions where food is prepared and portioned out in advance (5;19;22;30-32). This unfortunately does not translate well into real life situations where preparation and cooking is left up to the individual.

If these data accurately represent the dietary patterns of those trying to lose weight, successful weight loss is unlikely. Successful dietary modifications—energy restriction, lowering fat, require much knowledge, practice and self-monitoring. It is possible that

stricter dietary interventions may need to be implemented for successful weight loss. Again, this sheds light on the disconnect that exists between the changes people perceive they are making versus the changes they are actually making. Closing this gap is difficult and may be associated with a lack of education/knowledge, motivation, self-efficacy and resources.

More research is needed to address the dietary patterns that produce these estimates and the extent to which dietary modification leads to actual reductions in energy and macronutrient intakes. Furthermore, identifying the barriers to successful dietary modifications will be difficult, but crucial.Additional analyses were performed to assess the differences in rates of physical activity between those who did and did not exercise to lose weight (Table 4.7). Individuals who reported exercising to lose weight had significantly higher mean frequencies of moderate, vigorous and total physical activity (times per week) compared to those not exercising to lose weight; however, significantly higher activity frequency did not result in significant differences in duration. This translates to a higher proportion of total activity spent engaging in vigorous activity, but shorter duration per bout.

Exercised to lose weight	**Not exercising to lose weight**	**Exercising to lose weight**	**P**
Frequency (times/week)			
Moderate	3.1 (0.2)	4.0 (0.1)	<0.001
Vigorous	1.5 (0.2)	3.2 (0.2)	<0.001
Total	4.6 (0.2)	7.2 (0.2)	<0.001
Duration of activity (min/week)			
Moderate	158 (17)	169 (9)	0.580
Vigorous	96 (26)	139 (9)	0.111
Total	255 (31)	308 (14)	0.111

Table 4.7: Frequency and duration of physical activity among US adults exercising or not exercising to lose weight (n=2,352)

As indicated by the data, there is a stronger correlation between higher frequencies of vigorous activity than duration and persons exercising to lose weight. The literature supports these findings in that persons engaging more frequently in higher intensity physical activity are more likely to lose weight. Although, studies focusing on long-term maintenance of weight loss are limited, as participants report difficulty adhering to the high levels and intensity of exercise (36-40). Furthermore, a high degree of subjectivity is noted for reported intensity of physical activity. For instance, running was considered one of the most common vigorously-intense activities for normal weight persons, but not for obese persons (24). It is possible that these findings can redirect physical activity recommendations to improve exercise adherence rates. It may be less overwhelming for individuals if they know each bout of physical activity can be shorter if the intensity level is high enough. Shifting the focus from quantity to quality (in this case intensity) of activity may improve the overall effectiveness of exercising to lose weight.

Overall, the present study illustrates several important findings relative to weight accuracy and weight loss derived from self-reported data. Understanding each relationship independently allows for further discussion on how all of these relationships may be correlated. For instance, it was evident that middle-aged adults report their height and weight with a relatively high degree of accuracy, but that same accuracy did not correlate to BMI. Additional findings showed that obese people were more likely to report weighing less than they actually do, despite the greater proportion trying to lose weight compared to accurate, normal weight counterparts. Similar results were seen for females. The data also revealed that a person's beliefs about their weight status may be a greater predictor for attempted weight loss than weight accuracy and weight status for overweight and obese persons. In addition, data showed that adults seem to be incorporating the right approaches

for weight loss, such as reducing calorie and fat intakes and exercising, but may not be fully engaged. The subjectivity of types and intensities of physical activity showed discrepancies between subgroups.

This study presents with several limitations. First, dietary intake data are commonly associated with inaccuracies as evident through food frequency questionnaires and dietary recalls and reporting errors. Therefore, the data herein may not be truly representative of typical dietary patterns. Next, self-reported data is notoriously criticized for inaccurate translation of anthropometric measures as people oftentimes are unable to estimate these precisely. Although, for the purpose of this study, self-reported data was incorporated into the analyses and used advantageously as a variable for assessing weight accuracy. Another limitation present throughout the study dealt with limited analysis related to subgroup stratification. Further stratification in some analyses reduces sample sizes, which in turn can contribute to weak or insignificant correlations. A final limitation is associated with subjectivity of reported physical activity data. One person's perception of vigorous activity may be different from another's, which makes it very difficult to measure its impact on weight loss.

Conclusions

Contrary to previous findings, US adults have been reporting their height and weight with a high degree of accuracy, although, it remains certain subgroups are more prone to underreporting or overreporting these measures. It is interesting to find how these variables affect dietary and physical activity patterns especially for overweight and obese individuals. The numerous benefits of weight loss are well accepted, which is why the alarmingly high obesity rates are so discouraging. While people generally have a good understanding of their weight status, it appears that a person's perception about their weight is a stronger predictor for attempted weight loss.

It is apparent from the data that people realize the importance of a dual approach for initiating weight loss, but the dietary and physical patterns revealed are not favorable for weight loss. Greater attention to detail is needed for implementing more effective weight loss practices. For example, those reducing dietary fat to lose weight only showed small differences in percentages of calories from fat. Similarly, improvements in perceptions of physical activity need to be made due to the high degree of variability that exists with respect to quantity and quality of activities. For instance, stretching is considered a moderately-intense activity to one person while running is to another.

Addressing these inconsistencies is necessary to help bridge the gap between perception and reality. In order to achieve successful weight loss, one must not only have a solid understanding the types of lifestyle behaviors required, but how to effectively put these behaviors into action.

The results herein suggest that greater efforts may be necessary in order to adequately equip obese persons with the knowledge, tools and resources imperative for weight loss. Reinforcing the concept that overall healthy lifestyle habits are the driving forces behind lasting weight loss.

CHAPTER 5: COMMON WEIGHT LOSS PRACTICES AND COMPLIANCE IN US ADULTS

Abstract

Objectives: To examine common weight loss practices and compliance among middle-aged US adults.

Methods: Dietary and physical activity modifications were assessed in 2,352 overweight and obese adults attempting to lose weight from NHANES, 1999-2006.

Results: The majority of adults reported eating less food, exercising, eating less fat and eating fewer calories to lose weight. Over half of adults reported using up to 3 weight loss practices. Those who exercised to lose weight reported significant differences between physical activity, but not dietary modifications and weight loss practices.

Conclusions: These findings suggest that compliance to weight loss practices appears strong, but the data reveal efforts may not promote meaningful weight loss.

Keywords: weight loss; obesity; physical activity; dietary behaviors

Introduction

Obesity remains one of the most detrimental health conditions within our nation because of its unfortunate link to countless diseases, economic burdens and death. With over 66% of US adults considered overweight or obese, this public health concern continues to be a major focus for health professionals. Over the past 20 years the National Health and Nutrition Examination Survey (NHANES) has revealed some of the most significant increases in obesity prevalence most evident in middle-aged adults. Significant disparities exist between obesity prevalence and gender, as well as for race/ethnicity. The 2007-2008 NHANES data demonstrated an age-adjusted overweight and obesity prevalence of 68.0% (95% CI, 66.3%-69.8%) overall, 72.3% (95% CI, 70.4%-74.1%) among men, and 64.1% (95% CI, 61.3%-66.9%) among women (1;3).

The risk factors associated with obesity are numerous and well documented. Obesity contributes to the high rates of chronic diseases like cardiovascular disease, type 2 diabetes and hypertension—many of which can be managed or prevented. Lifestyle, genetic and environmental variables all contribute greatly to the complexity of this condition. Long-term overconsumption of calorie-dense foods, in addition to a sedentary lifestyle, paves the way for energy imbalances. Lifestyle behaviors, such as physical activity and dietary habits, are highly correlated with obesity status (4;5;21;25).

The literature indicates that relatively small reductions in body weight, 5 to 10%, can reduce obesity-related risk factors and improve health conditions. Weight loss through lifestyle modifications is the preferred first line of therapy for obesity. Diet and physical activity are the two most commonly modified variables to promote weight loss. US adults most commonly reported calorie restriction, low-fat diets, exercise or a combination of the

two as practices used for weight loss (26;28;29). Research suggests that successful, long-term weight loss is gradual and is the result of a healthy diet combined with physical activity (5;19;26;41;42).

One caveat to successful weight loss is compliance to weight loss regimens and reducing the barriers, such as lack of nutrition or health-related knowledge and lack of motivation or self-efficacy, related to weight loss (26;27). Reinforcing the idea that weight loss should be gradual and requires a commitment to a healthy lifestyle is an important part to helping improve self-efficacy and motivation. Furthermore, providing individuals with appropriate and accessible education and resources that help reduce barriers may also improve adherence to weight loss regimens.

While the literature has made significant headway with uncovering the etiology and epidemiology of obesity, efforts must still be made in order to better manage the current obesity epidemic by examining whether the types of weight loss practices employed will in fact successfully mediate weight loss. The purpose of this study was to examine the relationships between common weight loss practices and compliance in middle-aged US adults attempting to lose weight.

Methods

Data from the 1999-2006 continuous NHANES was used for the purpose of this study. The data were examined to determine the associations between weight status and weight loss practices in overweight and obese, middle-aged Americans. NHANES public use files were downloaded, whereupon the data was recoded and transformed to yield data relevant to the current study. This study further aimed to identify the role of dietary and physical activity patterns for those participants attempting to lose weight in a sample population of approximately 10,000 subjects. The following research questions were explored: what are the most common weight loss practices used by US adults and what is

the relationship between weight loss practices and compliance? Dietary modifications and physical activity patterns were assessed and compared across subgroups for: mean energy and macronutrient intakes; intensity, frequency and duration of physical activity.

Data Collection

NHANES Overview

NHANES is a program directed through the Centers for Disease Control and Prevention (CDC) designed to implement survey studies to monitor and evaluate the nutrition and health status of the U.S. population. This survey allows for examination of trends related to disease prevalence and associated risk factors. NHANES uses a complex, multi-stage, probability sampling study design. This design allows for subject selection representative of the current civilian, non-institutionalized U.S. population. About 5,000 persons are selected each year to participate in the survey from 15 different locations. Under-represented subgroups including low-income, African Americans, Hispanics and individuals 60 years of age or older are over-sampled so that the data more accurately represent the US population. Data collection for NHANES involves an in-home interview, questionnaires and a physical examination performed in a mobile examination center (MEC).

Subjects

A nationally representative sample of middle-aged US adults (31-50 years, N=5,759) was used for analysis. Pregnant females during data collection were excluded.

Data Sources

Physical activity data was extracted from the physical activity questionnaire as part of the NHANES in-home interview. An additional questionnaire focused on dietary intakes

was completed during the in-home interview, which was followed up with 2, 24-hour recalls following the MEC physical examination. Dietary intake data pertinent to the present study was used.

Data Preparation

Data from NHANES 1999-2006 was downloaded from the NCHS website, whereupon the data from the NHANES public files were converted into functional, relevant research information.

Sum of Weight Loss Behaviors

Weight loss practices for individuals trying to lose weight were self-reported and summated for frequency of use—energy restriction, low-fat diets, physical activity.

Physical Activity

Physical activity was self-reported by participants where they were asked which vigorous activities from a list of examples they performed over the past 30 days. Vigorous activity was defined as those "that caused heavy sweating or large increases in breathing or heart rate." Corresponding vigorous physical activity VPA was defined as having a metabolic equivalent (MET) level of ≥6.0. Participants were also asked to identify the types of moderate activities they performed in the last 30 days, which were considered activities "that caused light sweating or a slight to moderate increase in your heart rate or breathing." The corresponding MET level for moderate physical activity MPA was between 3.0 and 5.9. For each of the VPA and MPA activities performed, frequency and duration (in minutes) over the past 30 days was collected.

Data Analyses

The most commonly participated in weight loss practices were identified, whereupon frequency analyses were used to identify those in the study population attempting to lose weight and describe the weight loss practices used most frequently.

For individuals that indicated dietary changes for weight loss, energy and nutrient intakes were examined using raw nutrient and energy-adjusted intakes, and were compared for calories and macronutrients. Statistical analyses were done using log-transformed data to improve normality; means and standard errors were analyzed using non-log-transformed data.

Frequencies and duration of moderate, vigorous and total physical activity was computed from the raw data as means and standard errors. This allowed for comparison of physical activity levels as it relates to weight status, attempted weight loss and whether or not physical activity recommendations were being met.

SPSS Complex Samples (version 19.0, Chicago, IL) was used for analysis of the NHANES sample allowing for the correction of over-sampling of difficult-to-reach populations, which resulted in a nationally-representative sample. As the sample was increased to a national size, SPSS Complex Samples also allowed the appropriate standard errors for statistical analyses to be provided.

Results

About 44%, or 2,352 of the original 5,759 middle-aged adults selected for this study, reported trying to lose weight in the past year as indicated by in-home and MEC dietary and physical activity questionnaires. Calculated odds ratios indicated that females were 2.26 times more likely trying to lose weight than males. In addition, Table 5.1 shows that persons perceiving themselves to be overweight were 3.59 times more likely trying to lose weight. In addition, obese persons were 2.13 times more likely trying to lose weight compared to all other weight statuses.

The most common weight loss practices were summated for frequency and stratified by gender, perceived weight status and accuracy of self-reported weight (Table 5.2). The majority of individuals most commonly reported eating less food, exercising,

eating less fat, eating fewer calories and drinking a lot of water to lose weight (64%, 63%, 43%, 39% and 34%; respectively). Females were more likely to make dietary changes for weight loss, whereas males were more likely to exercise. Persons perceiving an overweight status indicated eating less food (65%) as the most common weight loss practice compared to persons perceived as about the right weight that most commonly exercised (72%). Overweight and normal weight individuals equally reported lowering calories to lose weight (39%). Individuals who reported weighing more than they actually do were most likely to exercise for weight loss compared to those reporting weighing less than they actually do and weight accurate individuals who were more likely to eat less food.

Table 5.3 shows the summation of weight loss practices where 84% of individuals reported using between 1 and 5 weight loss strategies. Males reported higher percentages for using fewer weight loss strategies compared to females. In addition, 57% of individuals perceived as overweight compared to 62% that perceived a normal weight status reported using up to 3 strategies for weight loss. In general, as the number of weight loss strategies increased, percentages decreased for overreporters, while percentages increased for underreporters.

Mean energy, fat and carbohydrate intakes were not significantly different for those who reported cutting calories, fat and carbohydrates, respectively, to lose weight, compared to those who did not (Table 5.4). For those that indicated dietary modification, there was a modest reduction in the percent of energy from fat and carbohydrate, respectively, if they reported such a modification, while also presenting with higher percentages of energy from protein.

Additional analyses were performed to assess the differences in rates of physical activity between those who did and did not exercise to lose weight (Table 5.5). Individuals who reported exercising to lose weight had significantly higher mean frequencies of

moderate, vigorous and total physical activity (times per week) compared to those not exercising to lose weight; however, significantly higher activity frequency did not result in significant differences in duration. This translates to a higher proportion of total activity spent engaging in vigorous activity, but shorter duration per bout.

Discussion

Overall, the present study illustrates several important findings relative to weight loss and compliance among middle-aged US adults. The majority of adults reported eating less food, exercising, eating less fat and eating fewer calories to lose weight, which highlights the possible complexity between weight accuracy and the likelihood to attempt weight loss. The data herein also suggest that perceived weight status may be a more powerful predictor compared to weight accuracy relative to attempted weight loss.

Related population studies(6;8-10), support the current study's findings that obese individuals are more likely to report weighing less than they actually do, but interestingly enough both overreporters and underreporters were less likely to have attempted weight loss compared to those who reported weight within 5%.

Most (84%) individuals reported using five or fewer weight loss strategies; less than 20% reported a single approach and half reported up to three different strategies. Males compared to females reported higher percentages for using fewer weight loss strategies. In general, as the number of weight loss strategies increased, percentages decreased for overreporters, while percentages increased for underreporters.

The data also showed that adults seem to be incorporating the right approaches for weight loss, such as reducing calorie and fat intakes and exercising, but may not be fully engaged. The subjectivity of types and intensities of physical activity showed discrepancies

between subgroups. For instance, running is more likely to be reported as a vigorously-intense activity for normal weight individuals, whereas obese individuals are more likely to report engaging in vigorously-intense walking (24).

Sustained weight loss and weight maintenance is primarily a result of combined dietary and physical activity modifications. It may be reasonable to speculate that, in general, people understand the combined efforts of diet and exercise are associated with weight loss, although, there may be a lack of knowledge and understanding concerning the degree of dietary and physical activity modifications are required for weight loss.

The US Department of Health and Human Services' 2008 Physical Activity Guidelines for Americans recommends that adults between 18 and 64 years of age engage in 2 hours and 30 minutes a week of moderate-intensity, or 1 hour and 15 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity (DHHS). Studies also indicated that individuals find it difficult to maintain the amount the duration and intensity of physical activity upon completion of weight loss interventions (37;39;40). The challenges that many have with meeting the recommended types and amounts of physical activity, in addition to lifestyle barriers that make it difficult to reach these activity goals becomes evident. Therefore, access to appropriate health education and resources can help close this knowledge gap.

This study presents with several limitations. Dietary intake data are commonly associated with reporting errors as evident through food frequency questionnaires and dietary recalls. Therefore, the data herein may not be truly representative of typical dietary patterns (45;46). Next, self-reported data is notoriously criticized for inaccurate translation of anthropometric measures as people are oftentimes unable to estimate height and weight precisely. Although, for the purpose of this study, self-reported data was incorporated into

the analyses and used advantageously as a variable for assessing weight accuracy. Another limitation present throughout the study dealt with limited analysis related to subgroup stratification. Further stratification reduces sample sizes for some subgroups, which in turn can contribute to weak or insignificant correlations. A final limitation is associated with subjectivity of reported physical activity data. One person's perception of vigorous activity may be different from another's, which makes it very difficult to measure its impact on weight loss.

Conclusion

The current study and related literature indicate that US adults are adhering to weight loss recommendations in a broad sense, but may not be doing enough. Improvements in education and resources are crucial to building knowledge and self-efficacy for implementing appropriate and effective weight loss practices.

Variable	Group	Trying to lose weight	OR (95% CI)
Total		44%	
Gender	Male	33%	Referent
	Female	54%	2.26 (2.00, 2.56)
Perceived Weight Status	Underweight	4%	0.27 (0.12, 0.59)
	About the right weight	21%	Referent
	Overweight	60%	3.58 (2.96, 4.32)
Weight Accuracy	>5% underestimation	50%	0.82 (0.65, 1.03)
	within 5%	45%	Referent
	>5% overestimation	23%	0.69 (0.57, 0.83)
Weight Status	Normal weight	26%	Referent
	Overweight	46%	1.75 (1.39, 2.21)
	Obese	61%	2.14 (1.69, 2.70)

Table 5.1: Proportion of US Adults who tried to lose weight in past year compared to perceived weight status, weight accuracy and weight status (n=5,759)

Practices to lose weight	Total (n=2352)	Gender		Weight Status		
		Male (n=883)	Female (n=1378)	Normal weight (n=339)	Over weight (n=801)	Obese (n=1118)
Ate less food	64%	60%	67%	65%	64%	64%
Exercised	63%	64%	62%	70%	69%	55%
Ate less fat	43%	40%	44%	41%	43%	42%
Lowered calories	39%	37%	41%	39%	38%	41%
Drank a lot of water	34%	29%	38%	30%	36%	35%
Skipped meals	20%	20%	20%	18%	19%	22%
Ate diet products	14%	10%	16%	12%	16%	13%
Took non-RX suppl.	12%	9%	14%	10%	12%	13%
Followed a special diet	11%	10%	11%	5%	8%	15%
Ate fewer carbohydrates	10%	9%	11%	13%	7%	12%
Used liquid diet formula	10%	7%	12%	10%	11%	10%
Joined program	8%	2%	12%	6%	8%	9%
Took RX diet pills	4%	2%	5%	2%	3%	5%
Other methods	3%	3%	2%	2%	2%	3%
Took laxatives	1%	1%	2%	1%	1%	2%
Started smoking	1%	1%	1%	1%	0%	1%
Changed eating habits	0%	0%	0%	0%	0%	0%
Ate less sugar, candy, sweets	0%	0%	0%	0%	0%	0%
Ate more fruits, vegetables, salads	0%	0%	0%	0%	0%	0%

Continued

Table 5.2: Common weight loss practices for US adults stratified by gender, perceived weight status and weight accuracy

Table 5.2 Continued

Practices to lose weight	Perceived Weight Status: Under-weight (n=10)	About right (n=357)	Over-weight (n=1893)	Accuracy of Self-reported Weight: >5% under (n=322)-	within 5% (n=1820)	>5% over (n=119)
Ate less food	53%	62%	65%	65%	65%	57%
Exercised	69%	72%	61%	59%	63%	58%
Ate less fat	48%	44%	42%	39%	43%	38%
Lowered calories	0%	39%	39%	38%	40%	35%
Drank a lot of water	29%	28%	36%	31%	36%	23%
Skipped meals	20%	16%	21%	22%	20%	18%
Ate diet products	9%	10%	14%	8%	15%	8%
Took non-RX suppl.	3%	7%	13%	16%	11%	14%
Followed a special diet	0%	6%	12%	9%	11%	5%
Ate fewer carbohydrates	0%	11%	10%	10%	11%	10%
Used liquid diet formula	13%	8%	11%	9%	10%	10%
Joined program	0%	5%	9%	6%	9%	0%
Took RX diet pills	0%	0%	5%	6%	4%	1%
Other methods	0%	2%	3%	2%	2%	6%
Took laxatives	0%	1%	2%	2%	1%	2%
Started smoking	0%	0%	1%	0%	1%	0%
Changed eating habits	5%	0%	0%	0%	0%	0%
Ate less sugar, candy, sweets	0%	0%	0%	0%	0%	0%
Ate more fruits, vegetables, salads	0%	0%	0%	0%	0%	0%

Number of strategies	Gender			Weight Status		
	Total	Male	Female	normal weight	Over-weight	Obese
1	19%	22%	17%	23%	18%	19%
2	20%	21%	20%	20%	23%	19%
3	18%	21%	17%	17%	18%	19%
4	16%	17%	16%	15%	16%	17%
5	11%	10%	12%	12%	11%	11%
6	7%	6%	8%	5%	7%	8%
7	5%	2%	6%	6%	5%	4%
8	3%	1%	4%	3%	3%	3%

Table 5.3: Number of weight loss strategies reported by US adults by gender, perceived weight status and weight accuracy

Modification to lose weight	Nutrient intakes	Employed modification to lose weight		
		No	Yes	P
Lowered calories	Energy (kcals)	2216 (34)	2171 (40)	0.414
	Fat (% of energy)	33.9 (0.4)	34.1 (0.5)	
	Carbohydrate (% of energy)	48.4 (0.4)	48.1 (0.6)	
	Protein (% of energy)	15.6 (0.2)	16.3 (0.4)	
Ate less fat	Total Fat (g)	86.1 (1.7)	81.2 (1.8)	0.065
	Fat (% of energy)	34.7 (0.4)	33.1 (0.4)	
	Carbohydrate (% of energy)	47.4 (0.4)	49.3 (0.6)	
	Protein (% of energy)	15.8 (0.2)	16 (0.3)	
Ate fewer carbohydrates	Carbohydrates (g)	264 (4)	245 (10)	0.114
	Fat (% of energy)	33.8 (0.3)	36 (0.7)	
	Carbohydrate (% of energy)	48.8 (0.4)	44 (0.8)	
	Protein (% of energy)	15.7 (0.2)	17.2 (0.5)	
Any Dietary Modification	Energy (kcal)	2219 (77)	2196 (26)	
	Protein (g)	84.2 (3.9)	85 (1.3)	
	Carbohydrate (g)	269 (11)	261 (4)	
	Total fat (g)	83.1 (3.4)	84.1 (1.3)	
	Saturated fatty acids (g)	27.3 (1.3)	27.6 (0.4)	
	Monounsaturated fatty acids (g)	30.7 (1.3)	31.2 (0.5)	
	Polyunsaturated fatty acids (g)	17.2 (0.9)	17.8 (0.3)	
	Fat (% of energy)l	33.2 (0.9)	34.1 (0.3)	
	Carbohydrate (% of energy)	49.8 (1.1)	48.1 (0.4)	
	Protein (% of energy)	15.4 (0.4)	15.9 (0.2)	
	Energy (kcal)	2219 (77)	2196 (26)	
	Protein (g)	84.2 (3.9)	85 (1.3)	

Table 5.4: Mean nutrient intakes and macronutrient distributions for dietary weight loss modifications in US adults

Exercised to lose weight	Not exercising to lose weight	Exercising to lose weight	P
Frequency (times/week)			
Moderate	3.1 (0.2)	4.0 (0.1)	<0.001
Vigorous	1.5 (0.2)	3.2 (0.2)	<0.001
Total	4.6 (0.2)	7.2 (0.2)	<0.001
Duration of activity (min/week)			
Moderate	158 (17)	169 (9)	0.580
Vigorous	96 (26)	139 (9)	0.111
Total	255 (31)	308 (14)	0.111

Table 5.5: Frequency and duration of physical activity among US adults exercising or not exercising to lose weight (n=2,352)

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