THE EFFECT OF WEIGHT MISPERCEPTION AND CONTEXTUAL FACTORS ON WEIGHT CONTROL AMONG YOUNG ADULTS

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ABSTRACT

Background: Overweight and obesity is a significant public health problem in the United States. Young adulthood is a particularly vulnerable period for excess weight gain and development of overweight/obesity. Although standard behavioral weight control programs can produce clinically significant weight losses, they routinely struggle to recruit young adults, particularly young men and African-Americans. This limits our understanding of the efficacy of these programs for these individuals. Weight misperception has been proposed as a potential barrier to attempting weight loss. Evidence also suggests education level, income status, family medical history, occupational demands, and depressive symptoms are individually associated with attempting weight loss. Against this backdrop, it is important to examine the relative influence of weight misperceptions and other contextual factors to better understand why young adults, particularly men and African-Americans, do not attempt weight loss.

Objective: To determine if observed differences in weight control by race and sex are due to differences in weight status perception accuracy among black and white young adults with overweight/obesity. The associations between contextual factors and weight loss attempts are also explored.

Methods: Data from 2756 young adults (20-39 years old) who participated in the 2007-2014 National Health and Nutritional Examination Survey (NHANES) were analyzed. Logistic regression models examined the effect of weight status perception accuracy and contextual factors on weight loss attempts among young adults and men specifically. Moderation by sex was assessed in the sample as a whole and moderation by race in analyses limited to young adult men. Sensitivity analyses using a higher BMI threshold (BMI ≥ 27 kg/m$^2$) were conducted to ensure that participants with a minimal weight misperception did not unduly influence findings.

Results: Overall, 31% of young adults had an inaccurate weight status perception, with a significantly higher number of men, particularly black men, reporting an inaccurate perception of their weight. Young adults, and men specifically, were significantly more likely to report a weight loss attempt if they accurately perceived their weight (*OR*=3.66, *95% CI* 2.80-4.77, $p<0.01$; *OR*=3.73; *95% CI* 2.76-5.03; $p<0.01$, respectively). However, there was no moderation by sex or race. Higher education level and income status were associated with weight loss attempts among young adults in models that included both sexes and in those that were limited to men. Although not significant in the larger model, greater self-reported depressive symptoms were associated with weight loss attempts in analyses limited to young adult men. Sensitivity analyses were largely consistent with these findings.

Conclusion: Most young adults with overweight/obesity accurately perceive their weight status. Weight status perception accuracy and certain contextual factors are important predictors of weight loss attempts among black and white young adults. Neither sex nor race moderated the association between weight status perception accuracy and weight loss attempts. These findings have implications for future research to better understand weight status perception and improve enrollment of young adults in weight control programs.

DEDICATION

I dedicate this work to several people who have provided immeasurable support to me during my doctoral studies. Completing this program would have been impossible without the love and guidance of my family – Mom, Dad, and James. Your willingness to listen to me talk about the ups and downs of my educational journey is deeply appreciated. I cannot thank you enough for reviewing my drafts of various assignments and providing excellent constructive criticism. I hope I can continue to make you proud moving forward with my career.

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CHAPTER 1

BACKGROUND

## Overweight and Obesity Among Adults

Overweight and obesity, defined as a body mass index (BMI) of 25.0-29.9 kg/m$^2$ and ≥ 30 kg/m$^2$, respectively, is a significant public health problem in the United States. Recent national estimates indicate that 78 million, or more than one-third, of adults have obesity (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016; Ogden, Carroll, Kit, & Flegal, 2013, 2014). The prevalence of obesity is higher in some racial/ethnic minority groups, with Hispanic and non-Hispanic black adults having a higher prevalence than non-Hispanic white or Asian adults (Flegal et al., 2016; Ogden et al., 2013, 2014). Among young adults, the prevalence of obesity has increased significantly over the past 30 years; 34% of adults aged 20-39 years in the US now have obesity (Flegal et al., 2016; Gordon-Larsen, The, & Adair, 2010; Ogden et al., 2014).

The prevalence of obesity among adults has significantly increased over the past several decades (Flegal et al., 2016; Ogden et al., 2013, 2014). Specifically, data from the National Health and Nutrition Examination Survey (NHANES) demonstrate the prevalence of obesity increased by nearly 10% from the 1970s to the 1990s (Flegal, Carroll, Kuczmarski, & Johnson, 1998). Recent evidence suggests the prevalence may be plateauing for certain groups, including women, but continuing to increase for men from all racial/ethnic groups (Flegal, Carroll, Kit, & Ogden, 2012). Despite some promising trends for certain populations, reducing the proportion of adults who have obesity is an important objective in Healthy People 2020 ("Healthy people 2020," 2010).

Overweight and obesity are associated with an increased incidence of developing numerous chronic health conditions, including diabetes, hypertension, stroke, and early mortality (Saydah, Bullard, Imperatore, Geiss, & Gregg, 2013). In addition, there is strong evidence to support an association between overweight/obesity and increased risk of cardiovascular disease (CVD), some cancers, and psychosocial distress (Jensen et al., 2014; Luppino et al., 2010). Individuals with obesity are also more likely to report poor physical well-being, low levels of self-acceptance, and more weight-based discrimination than their normal weight counterparts (Jackson, Beeken, & Wardle, 2015; Latner, Durso, & Mond, 2013)

Management of obesity and its comorbidities is expensive (Finkelstein, Trogdon, Cohen, & Dietz, 2009; Jensen et al., 2014; Kim & Basu, 2016). In 2014, the medical costs attributable to obesity were estimated to be $149 billion with an individual with obesity having medical costs approximately $1900 higher than those of a normal weight individual (Kim & Basu, 2016). If overweight/obesity prevalence continues to increase, the direct healthcare costs of obesity are estimated to be between $860 and $956 billion by 2030 (Wang, Beydoun, Liang, Caballero, & Kumanyika, 2008). The high health and financial burden of this disease makes finding solutions to the obesity epidemic imperative to improve the overall well-being of individuals in the United States and worldwide.

## Genetic, Behavioral, and Environmental Risk Factors

Several factors contribute to obesity, including genetics, behavior, and the environment. Findings from twin studies have demonstrated that the amount of weight gained or lost is dependent on an inherited predisposition (Albuquerque, Stice, Rodriguez-Lopez, Manco, & Nobrega, 2015; Bouchard, 2007; Bouchard et al., 1990; Bouchard et al., 1994; Hainer et al., 2000). Feelings of hunger, satiety, and a propensity for sedentary behavior may also have a genetic basis (Bouchard, 2007; Choquet & Meyre, 2011). However, due to the slow pace of genetic change in human populations, genetics alone is inadequate as an explanation for the sudden rise in obesity prevalence (Bouchard, 2007; Sellayah, Cagampang, & Cox, 2014). Instead, genetic factors interact with the environment to influence behavior and produce variation in one's risk of obesity (Bouchard, 2007).

Behavioral factors, such as excessive caloric consumption and insufficient physical activity, are significant contributors to obesity because they influence energy balance. Energy balance refers to the relationship between the energy content (i.e., kilocalories [kcal]) of consumed food and the energy used to maintain life and perform physical activity (Hall et al., 2011). Weight change occurs when there is an imbalance between consumed energy and energy expenditure. Specifically, weight gain results from greater energy consumption than energy expenditure and obesity occurs if this imbalance persists over time. To avoid excess weight gain, individuals are recommended to limit their caloric intake to approximately 2000 kcal per day on average, by eating a healthy diet consisting of low-calorie, nutrient-dense foods such as fruits, vegetables, whole grains, low-fat dairy products, seafood, lean meats and poultry, eggs, beans and peas, and nuts and seeds (US Department of Health Human Services, 2015). However, many individuals are not consuming a diet that adheres to these recommendations (Blanck, Gillespie, Kimmons, Seymour, & Serdula, 2008; Li et al., 2000; Moore & Thompson, 2015; Patterson, Block, Rosenberger, Pee, & Kahle, 1990; Serdula et al., 2004). For example, in 2013, fruit and vegetable intake recommendations were met by only 13% and 9% of adults, respectively, according to the data from the Behavioral Risk Factor Surveillance System (Moore & Thompson, 2015). This low adherence has persisted since the late 1970s (Blanck et al., 2008; Li et al., 2000; Patterson et al., 1990; Serdula et al., 2004). Of particular relevance to the present study, significant declines in fruit and vegetable consumption have been observed in some samples of young adult men and

African-Americans (Casagrande, Wang, Anderson, & Gary, 2007; Clarke, O'Malley, Johnston, Schulenberg, & Lantz, 2009).

In contrast, individuals report increased and excessive consumption of energy-dense snacks, fast food, and sugar-sweetened beverages (Nielsen & Popkin, 2004; Nielsen, Siega-Riz, & Popkin, 2002a, 2002b), which contribute to the accumulation of excess weight (Ludwig et al., 1999; W. C. Miller, Lindeman, Wallace, & Niederpruem, 1990; Pereira et al., 2005). Specifically, adults' energy intake is composed of approximately 27% energy-dense, nutrient-poor foods, such as desserts and salty snacks; snacking frequency has also increased significantly since the 1970s (Kant, 2000; Kant & Graubard, 2015; Piernas & Popkin, 2010). Similarly, adults now consume approximately 21% of their total energy in energy-dense meals eaten at sit-down and fast food restaurants (Kant & Graubard, 2004; Lachat et al., 2012). Sugar-sweetened beverage consumption has also significantly increased over time to become the largest source of beverage calories in adults' diets (Bleich, Wang, Wang, & Gortmaker, 2009). All of these dietary choices put adults at increased risk for obesity and have been associated with the rapid rise in obesity prevalence over the past several decades (Kant & Graubard, 2015; Lachat et al., 2012; Malik, Pan, Willett, & Hu, 2013).

In addition to excessive caloric intake, adults do not achieve recommended levels of physical activity. Adults are recommended to engage in at least 150 minutes of moderate intensity physical activity (e.g., brisk walking), plus two days of strength training per week to control energy balance and maintain weight (Physical Activity Guidelines Advisory Committee, 2008). However, national estimates indicate that fewer than 10% of American adults meet physical activity guidelines (Tucker, Welk, & Beyler, 2011). These estimates have changed little over the years, though males, young adults, and non-Hispanic whites consistently report engaging in more physical activity than other groups (Carlson, Fulton, Schoenborn, & Loustalot, 2010). Conversely, amount of time spent in sedentary behaviors (e.g., watching television) has increased over time and shows strong tracking from adolescence to adulthood (Anderssen et al., 1996; Gordon-Larsen, Nelson, & Popkin, 2004). Approximately 35% of adults spend four or more hours a day watching television, videos, or using a computer (E. S. Ford, Kohl, Mokdad, & Ajani, 2005). Spending substantial amounts of time in sedentary activities has been linked to weight gain (Raynor, Phelan, Hill, & Wing, 2006), CVD risk factors (Grontved et al., 2014; Gustat, Srinivasan, Elkasabany, & Berenson, 2002), and all-cause and CVD mortality (Proper, Singh, van Mechelen, & Chinapaw, 2011; Warren et al., 2010). Taken together, low levels of physical activity and high levels of sedentary behaviors are other important factors contributing to the high prevalence of obesity among adults in the US.

The environment also contributes to obesity risk as it influences one's ability to eat a healthy diet and engage in adequate physical activity (Moore, Diez Roux, Nettleton, & Jacobs, 2008). If healthy foods are not easily accessible or affordable, then individuals will find it challenging to eat according to recommended dietary guidelines and can resort to eating higher calorie foods with less nutritional value that may be more affordable and accessible (e.g., fast food). There are disparities in access to affordable, healthy food across the US and these disparities are associated with diet quality and thus weight status (Black, Moon, & Baird, 2014; Casagrande, Whitt-Glover, Lancaster, Odoms-Young, & Gary, 2009; Caspi, Sorensen, Subramanian, & Kawachi, 2012; P. B. Ford & Dzewaltowski, 2008; N. I. Larson, Story, & Nelson, 2009; Lovasi, Hutson, Guerra, & Neckerman, 2009; Michimi & Wimberly, 2010; Zenk et al., 2005). Specifically, residents in low-income and minority neighborhoods have poor access to supermarkets and healthy food, yet greater access to fast-food restaurants and energy-dense foods, which adversely impacts dietary quality and obesity prevalence (N. I. Larson, Story, et al., 2009).

If environments are perceived as unsafe or do not support active forms of transportation and recreation then residents' opportunities for energy expenditure will be limited. For example, low perceptions of neighborhood safety tend to be associated with reduced levels of physical activity (Bennett et al., 2007; Foster & Giles-Corti, 2008). The "built environment," defined as how land is designed and used by individuals (e.g., physical activity-related facilities, public transportation systems) (Handy, Boarnet, Ewing, & Killingsworth, 2002), can also significantly influence opportunities for physical activity (Gordon-Larsen, Nelson, Page, & Popkin, 2006). Built environments which promote activities, such as walking and biking, are associated with increased engagement in these activities and may relate to a lower risk of obesity among residents (Ding & Gebel, 2012; Durand, Andalib, Dunton, Wolch, & Pentz, 2011; Gordon-Larsen et al., 2006; Heath et al., 2006; McCormack & Shiell, 2011; Mumford, Contant, Weissman, Wolf, & Glanz, 2011; Sallis, Floyd, Rodriguez, & Saelens, 2012; Sallis & Glanz, 2009; Task Force on Community Preventive Services, 2002). For example, greater availability of physical activity facilities is associated with increased bouts of moderate to vigorous physical activity for young adult men (Boone-Heinonen, Guilkey, Evenson, & Gordon-Larsen, 2010). In sum, an individual's risk of obesity is influenced by numerous factors, including genetics, behavior, and the environment. Given the high rates of obesity and its associated comorbidities, numerous environmental and behavioral interventions have been tested. Behavioral interventions are designed to target modifiable behaviors to reduce obesity risk and its sequelae and are the focus of the present study.

## Obesity Treatment and Prevention

The Diabetes Prevention Program (DPP) (Knowler et al., 2002) and the Look AHEAD (Action for Health in Diabetes) study (Pi-Sunyer et al., 2007; Ryan et al., 2003) exemplify lifestyle modification approaches needed to address obesity and its comorbidities in adult populations. The DPP randomly assigned 3234 adults 25 years of age and older (32% male) with impaired glucose tolerance to one of three groups: placebo, metformin, or a lifestyle modification program with goals of at least 7% weight loss and at least 150 minutes of physical activity per week. Participants in the lifestyle intervention were also advised to consume a reduced-calorie (1200-2000 kcals per day based on body weight), low-fat diet ("The Diabetes Prevention Program (DPP): description of lifestyle intervention," 2002). The lifestyle intervention consisted of 16 individual counseling sessions for the first 24 weeks followed by additional sessions offered at least every other month.

Participants in the lifestyle intervention group lost an average of 5.6 kg compared to losses of 2.1 kg and 0.1 kg in the metformin and placebo groups, respectively, after nearly three years (Knowler et al., 2002). In addition, the lifestyle intervention reduced the incidence of type 2 diabetes by 58% compared to placebo and by 39% compared to metformin (Knowler et al., 2002). However, losses were significantly smaller in younger DPP participants (aged 25-44 years), who experienced an average weight loss of 4.1 kg compared to losses of 5.0 kg and 6.4 kg for middle-aged (45-59 years) and older (60-85 years) participants, respectively (Crandall et al., 2006). Participants in the lifestyle intervention group nearly regained to their baseline weight according to ten-year follow-up data, but the incidence of type 2 diabetes was still lowest in this group, with a 34% reduction in risk compared with placebo (Knowler et al., 2009).

Given these promising long-term health results brought on by modest weight loss, the DPP experienced widespread translation to numerous settings, with only small reductions in effectiveness (Ali, Echouffo-Tcheugui, & Williamson, 2012). However, one recent systematic review of 17 studies examining the effectiveness of DPP translations among African Americans demonstrates that these translations have been suboptimal for this group with respect to weight loss (Samuel-Hodge, Johnson, Braxton, & Lackey, 2014). Specifically, African-American participants in these translations lost approximately 2.8 kg on average, half of the weight loss achieved in the original DPP (Samuel-Hodge et al., 2014). Thus, there is evidence for effective weight loss strategies involving lifestyle modification, but these strategies do not seem to meet the needs of young adults and African-Americans. Different strategies that can address the numerous contextual factors that disproportionately impact these groups are likely needed.

Following the DPP, the Look AHEAD study was initiated to determine the long-term health consequences of intentional weight loss (Ryan et al., 2003). This trial randomized more than 5,100 adults aged 45-74 years (40% male) with overweight/obesity and type 2 diabetes to an intensive lifestyle intervention similar to the DPP or a diabetes support and education (DSE) group (Pi-Sunyer et al., 2007; Ryan et al., 2003). The lifestyle intervention was designed with goals of at least 7% weight loss and at least 175 minutes of physical activity per week (Ryan et al., 2003). The intervention consisted of three group sessions and one individual visit per month for the first six months of year 1. Intervention participants attended two group sessions and one individual visit each month for the last six months of year 1 and substituted one meal per day with a meal replacement (e.g., SlimFast shakes) (Ryan et al., 2003). Notably, men attended more treatment sessions and had better adherence to the diet and physical activity prescriptions than women, which may have contributed to their significantly greater weight losses after 1 year

(Espeland et al., 2009; Wadden et al., 2009). In contrast, African-Americans experienced smaller weight losses compared with non-Hispanic white participants, even after controlling for differences in session attendance and intervention adherence (Wadden et al., 2009).

The focus of the intervention shifted in years 2-4 to help those who had achieved the goals maintain their weight loss and high levels of physical activity, or effectively motivate participants who had not yet achieved these goals, by offering participants one monthly individual session and one phone or e-mail contact with periodic group sessions (Wadden et al., 2011). Participants in the lifestyle intervention group lost an average of 8.6% of their initial weight compared with a 0.7% average loss in the DSE group at one-year follow-up (Pi-Sunyer et al., 2007). Moreover, significantly greater improvements in fitness, hemoglobin A1c, and measures of CVD risk were observed in the intervention group compared to the DSE group (Pi-Sunyer et al., 2007). After 4 years, lifestyle intervention participants maintained an average loss of 4.7% of their initial weight – significantly greater than the 1.1% average weight loss in the DSE group (Wing, 2010). Finally, a mean weight loss of 6.0% was observed in the intervention group compared with a mean weight loss of 3.5% in the DSE group at the end of the trial, nearly ten years after it started (Wing et al., 2013).

Taken together, the DPP and Look AHEAD offer insight into effective lifestyle interventions to promote weight loss as well as the long-term health outcomes of losing weight. Specifically, caloric restriction is a key determinant of weight loss, and this can be accomplished by decreasing portion sizes and/or reducing the energy density of the diet (Wadden, Webb, Moran, & Bailer, 2012). To promote successful weight loss, a comprehensive lifestyle program should last at least six months, with participants meeting a trained interventionist at least twice per month (Butryn, Webb, & Wadden, 2011; Jensen et al., 2014; Wadden & Foster, 2000;

Wadden et al., 2012). Physical activity also supports weight loss, and evidence suggests bouts of programmed exercise or increased daily lifestyle activity can be effective for weight loss maintenance and improving cardio-metabolic outcomes (Andersen et al., 1999; Jakicic, Donnelly, Pronk, Jawad, & Jacobsen, 1995; Murphy, Blair, & Murtagh, 2009; Wadden et al., 2012). Individuals who are successful in losing weight should participate in long-term weight loss maintenance programs that encourage high levels of physical activity, consuming a reduced-calorie diet, and monitoring body weight (Svetkey et al., 2008; Wadden et al., 2012).

Obesity prevention for adults shares many of the same behavioral strategies with initiating and sustaining long-term weight loss (Jensen et al., 2014). Though research on effective obesity prevention programs is relatively scarce compared to research on treatment programs, systematic reviews of prevention programs with adults suggest comprehensive lifestyle interventions targeting improved dietary intake, physical activity, or both, can be effective in preventing weight gain and decreasing the risk of comorbidities in adults (Brown et al., 2009; Hebden, Chey, & Allman-Farinelli, 2012; Laska, Pelletier, Larson, & Story, 2012; Lemmens, Oenema, Klepp, Henriksen, & Brug, 2008). However, systematic reviews note several limitations of prevention studies, including the heterogeneity of study designs and program components, small sample sizes, short duration, and underrepresentation of young adults and men (Lemmens et al., 2008). In sum, there is a well-established evidence base for effective obesity treatments in adults and emerging evidence for effective obesity prevention approaches. Yet, due to the underrepresentation of young adults and men in both obesity prevention and intervention studies, it is unclear if the findings from these studies are applicable to these groups.

## Overweight and Obesity Among Young Adults

This vast evidence base for effective obesity intervention approaches has limited generalizability to certain groups, namely young adults (Gokee-LaRose, Gorin, Raynor, et al., 2009; M. C. Nelson, Story, Larson, Neumark-Sztainer, & Lytle, 2008). Specifically, Gokee-LaRose et al. (2009) have found that young adults are less likely than older adults to attend sessions and remain in behavioral weight control programs, which results in significantly lower mean weight losses for young adults. These findings are supported by additional research, with younger age emerging as the most consistent demographic predictor of attrition in adult weight loss trials (Clark, Niaura, King, & Pera, 1996; Dalle Grave et al., 2004; Dalle Grave et al., 2005; Fabricatore et al., 2009; Honas, Early, Frederickson, & O'Brien, 2003). Current behavioral weight control programs may not be sufficiently appealing to young adults, and it has been suggested that more needs to be done to adapt these programs (Gokee-LaRose, Gorin, Raynor, et al., 2009). In light of these findings, young adults have been the focus of increased intervention efforts designed to treat or prevent obesity (Lytle et al., 2014).

Beyond lack of enrollment and response to treatment, there are a number of additional reasons for developing effective interventions for young adults. Recent estimates indicate 62% of men and 59% of women 20-39 years of age have overweight or obesity (Ogden et al., 2014). Moreover, individuals experience the greatest rate of weight gain during young adulthood, often gaining one to two pounds per year (C. E. Lewis et al., 2000). Having overweight/obesity or gaining weight during young adulthood is also associated with an increased risk of numerous comorbidities, such as the metabolic syndrome (Carnethon et al., 2004; Truesdale et al., 2006), and poor outcomes later in life, including sustained obesity and early mortality (Gordon-Larsen et al., 2010; Saydah et al., 2013).

These findings are corroborated by studies demonstrating that young adults generally report poor dietary habits, including low consumption of whole grains, fruits, and vegetables (Clarke et al., 2009; N. Larson, Laska, Story, & Neumark-Sztainer, 2012; N. I. Larson, Neumark-Sztainer, Story, & Burgess-Champoux, 2010; M. C. Nelson, Larson, Barr-Anderson, Neumark-Sztainer, & Story, 2009), as well as behaviors that adversely impact dietary quality, such as low levels of food preparation (N. I. Larson, Perry, Story, & Neumark-Sztainer, 2006) and sitting down to eat a meal (N. I. Larson, Nelson, Neumark-Sztainer, Story, & Hannan, 2009). Consumption of high-calorie foods at fast food establishments and sit-down restaurants has more than doubled among young adults since the 1970s, while consumption of foods at home has dropped by almost 20 percent (Nielsen et al., 2002b; Smith, Ng, & Popkin, 2013). Sugar sweetened beverage consumption is highest among young adults compared to adults of other ages, now adding approximately 290 calories to their daily dietary intake (Bleich et al., 2009). Increases in sugar-sweetened beverage consumption have been pronounced among young men, especially African-American men (Bleich et al., 2009). Importantly, young adults report lack of time as a consistent barrier to healthy eating (N. I. Larson, Nelson, et al., 2009; N. I. Larson et al., 2006), especially among the 21% of young adults who work more than 40 hours per week (Escoto, Laska, Larson, Neumark-Sztainer, & Hannan, 2012).

Young adults also report high levels of sedentary behavior and low levels of physical activity. Specifically, young adult men and women report 19 and 15 hours per week of television and video screen time, respectively (Boone, Gordon-Larsen, Adair, & Popkin, 2007). Young African-American men, in particular, engage in high amounts of screen time, reporting 4.5 hours of TV watching per day compared to 3.2 hours for white young men (Gustat et al., 2002). Increased screen time is associated with increased caloric intake (Marsh, Ni Mhurchu, &

Maddison, 2013). For example, one recent study found that young men consumed 353 more calories than women while engaging in sedentary screen time such as watching TV or playing video games (Lyons, Tate, Ward, & Wang, 2012). Further, self-reported moderate-to-vigorous physical activity decreases during the transition from adolescence to young adulthood, with young adult males and females reporting 5.3 and 3.4 hours per week of moderate-to-vigorous physical activity, respectively (Walters, Barr-Anderson, Wall, & Neumark-Sztainer, 2009).

Qualitative research on college students supports these results, indicating that this group struggles to adapt healthy eating and exercise behaviors to college life (Ashton, Hutchesson, et al., 2015; Cluskey & Grobe, 2009; Greaney et al., 2009; M. C. Nelson, Kocos, Lytle, & Perry, 2009; Sabinsky, Toft, Raben, & Holm, 2007; Walsh, White, & Greaney, 2009). Specifically, they view stress, temptation, social influences, the wide availability of unhealthy food, and time and financial constraints as consistent barriers to weight control and an overall healthy lifestyle (Ashton, Hutchesson, et al., 2015; Cluskey & Grobe, 2009; Greaney et al., 2009; M. C. Nelson, Kocos, et al., 2009; Sabinsky et al., 2007; Walsh et al., 2009). This age group, especially young adult men and African-Americans (Grier & Kumanyika, 2008), is also highly coveted by food and beverage marketers seeking to build brand loyalty for their products and create life-long consumers (M. C. Nelson, Story, et al., 2008). Given their unhealthy weight-related behaviors, young adulthood has been identified as a high-risk period for the development of obesity and an important age for intervention (Lytle et al., 2014; M. C. Nelson, Story, et al., 2008).

Young adulthood is also viewed as a critical period for health decision-making and establishing long-term health behaviors. This is largely because of increased recognition that young adulthood, including the smaller age window of emerging adulthood (i.e., 18-25 years of age), is a distinct developmental period characterized by greater social independence and fewer expectations (Arnett, 2000; M. C. Nelson, Story, et al., 2008). Arnett and others have argued that this period is unique from both adolescence and adulthood because of the identity development and role exploration that occurs during this life stage (Arnett, 2000, 2007; M. C. Nelson, Story, et al., 2008). Integrating characteristics of a healthy lifestyle into one's identity at this age is key for the creation of long-term health behavior patterns (K. H. Miller, Ogletree, & Welshimer, 2002; Storer, Cychosz, & Anderson, 1997). Moreover, important psychosocial constructs known to positively impact health behaviors, such as self-efficacy, are established and developed during young adulthood (S. J. Schwartz, Côté, & Arnett, 2005).

Role exploration is reflected in the high demographic variability during this period, meaning that young adults move out of their parents' home and become increasingly mobile while searching for new educational or career opportunities (Arnett, 2000, 2007). As a result, the influence of parents, family, and friends begins to change and serve different roles as compared to childhood or adolescence (M. C. Nelson, Story, et al., 2008). For example, young adults' conflicts with their parents decrease as their parents begin to exert less authority over them (Aquilino, 1997) and young adults become more attached to their peers and romantic partners (Fraley & Davis, 1997). Further, young adults place greater importance on accepting responsibility for one's self, making independent decisions, and becoming financially independent as they make the transition from adolescence to adulthood (Arnett, 1997, 1998; Greene, Wheatley, & Aldava, 1992). Given the identity development and role exploration that occurs during young adulthood, unhealthy habits established during this age could persist into adulthood unless effective strategies are designed to influence the weight-related behaviors of young adults.

## Weight Control Interventions for Young Adults

Several studies have now targeted these weight-related behaviors and psychosocial constructs to determine what may be most effective for obesity prevention and treatment in young adults. Laska et al. (2012) reviewed 37 interventions for weight gain prevention for 18-35 year olds, many of which focused on individual-level delivery and showed encouraging results, though only as small-scale pilot studies. The authors concluded: (1) university course-based interventions positively influence weight status, BMI, and/or body composition, though with small effect sizes, (2) interventions centered on principles of self-regulation exhibit positive findings for weight gain prevention, and (3) interventions focused on modifying dietary intake have a positive impact on diet, whereas physical activity interventions produce inconsistent effects on activity (Laska, Pelletier, et al., 2012). Importantly, given that samples for the reviewed studies were predominantly female and non-Hispanic white, the authors note a critical need to develop weight control interventions for young adult men and minorities because of their increased risk for excess weight gain (Laska, Pelletier, et al., 2012).

Similarly, in a meta-analysis of nine randomized-controlled trials for preventing weight gain in young adults, Hebden et al. (2012) found that participants randomized to receive the intervention lost approximately 1 kg more than participants randomized to control conditions. For example, one study included in this meta-analysis observed that 67 sedentary men aged 25-40 years with a BMI between 22-30 kg/m$^2$ randomized to a home- or clinic-based program focused on increasing aerobic exercise and decreasing fat intake lost 1.6 kg more than a delayed treatment control group after four months (Leermarkers, Jakicic, Viteri, & Wing, 1998). As a whole, Hebden et al. (2012) report that effective interventions were in alignment with evidence-based weight control guidelines, and included components focused on self-regulation and self-monitoring of weight-related behaviors, provided tailored feedback, had an initial consultation meeting with participants before following up with additional meetings or phone/email support, and sought to increase physical activity and decrease dietary energy density.

Consistent with preventive interventions, Poobalan et al. (2010) reviewed 14 weight loss interventions among young adults between the ages of 18-25 years and determined that these interventions improved both psychosocial (e.g., self-efficacy and self-esteem) and physiological outcomes, such as cholesterol and insulin, in addition to promoting weight loss. Interventions combining diet, exercise, and motivational skills produced average weight losses of nearly 3 kg (Poobalan et al., 2010). However, the reviewed studies had small sample sizes, ranging from 16 to 67 participants, (Poobalan et al., 2010). In sum, these reviews suggest potential approaches that may be efficacious for obesity prevention and treatment for young adults, including education on self-regulation and improving diet and physical activity. These findings are supported by other small pilot studies not included in these reviews, which have also shown improvements in the representation of racial/ethnic minorities in study samples (Gokee-Larose, Gorin, & Wing, 2009; Napolitano, Hayes, Bennett, Ives, & Foster, 2012). However, these studies still struggled to recruit young men, particularly African-American men, which limits the generalizability of findings.

In an effort to overcome these limitations and improve the evidence base for effective weight control interventions in young adults, a consortium of studies, the Early Adult Reduction of weight through LifestYle (EARLY) intervention trials, was established (Lytle et al., 2014). Each of these studies tested a unique 24-month intervention for 18-35 year olds with change in weight or BMI as the primary outcome (Lytle et al., 2014). For example, the Cell Phone Intervention for You (CITY) randomized controlled trial tested a weight loss intervention delivered solely by an interactive mobile smartphone application compared with personal coaching enhanced by smartphone self-monitoring among 365 young adults (70% female, 56% white) (Svetkey et al., 2015). Findings demonstrated that the CITY intervention did not lead to greater weight loss relative to the control group (Svetkey et al., 2015). Alternatively, the Innovative approaches to Diet, Exercise, and Activity (IDEA) study showed that a standard behavioral weight loss intervention (i.e., prescribing an energy-restricted diet and increased moderate-to-vigorous physical activity) with weekly group sessions was effective in reducing weight and body fat and improving weight-related biomarkers in 470 young adults (71% female, 77% white) (Jakicic et al., 2015). The Study of Novel Approaches to Weight Prevention (SNAP) randomized 599 participants (78% female, 73% white) to self-regulation plus small changes in diet and physical activity, or self-regulation plus large changes in diet and physical activity, or control (Wing et al., 2016). Participants in the large changes group lost an average of 2.37 kg compared to a 0.56 kg loss in the small changes group and a 0.26 kg gain in the control group after an average of three years (Wing et al., 2016). Notably, SNAP researchers made significant efforts to recruit men and minorities into this study by conducting formative work and pairing with a marketing firm to create recruitment materials, yet were only able to recruit 22% men and 4.5% minority males (Tate et al., 2014), thus limiting the generalizability of their findings (Wing et al., 2016). As a whole, although the EARLY trials demonstrate some efficacy and overcome the limitations of previous studies by utilizing strong study designs and large samples, studies are still not reaching young or minority males, suggesting a need for further research on how to enroll these groups in behavioral weight control programs.

## Overweight and Obesity Among Young Adult Men

Men are historically underrepresented in weight control trials, particularly ethnic minority men and young adult men. Yet, rates of obesity and associated comorbidities continue to increase among men. Recent national estimates indicate that 29% and 33% of white and black young adults are classified as having obesity, respectively (Flegal et al., 2016). During young adulthood, men have higher BMIs than women and white and black men experience average five-year gains of nine and 13 pounds, respectively (G. L. Burke et al., 1996; Cluskey & Grobe, 2009; Huang et al., 2003; T. F. Nelson, Gortmaker, Subramanian, Cheung, & Wechsler, 2007; Norman, Bild, Lewis, Liu, & West, 2003; Racette, Deusinger, Strube, Highstein, & Deusinger, 2008). This weight gain is associated with greater increases in triglycerides and blood sugar among young adult men compared to women (Norman et al., 2003). Several factors are likely responsible for this excess weight gain among young adult men. Fruit and vegetable consumption among young adult men has declined significantly since the 1980s (Clarke et al., 2009; Sijtsma et al., 2012) and young adult men are not highly engaged in food preparation, which lowers the overall quality of their diets (N. I. Larson et al., 2006; Laska, Larson, Neumark-Sztainer, & Story, 2012). Further, young men consistently report high levels of physical activity, although they still do not meet national recommendations (Clarke et al., 2009; Huang et al., 2003; T. F. Nelson et al., 2007; Racette et al., 2008). Given these poor health outcomes and weight-related behaviors, as well as underrepresentation in trials, there have been calls to develop more effective lifestyle interventions to prevent and treat obesity in young men (Lytle et al., 2014; M. C. Nelson, Story, et al., 2008; Tate et al., 2014).

There is an even greater need to develop efficacious obesity treatment and prevention programs for young adult African-American men. Research suggests that health outcomes for young African-American men are worse than outcomes for their white counterparts. Compared to white young adults with overweight, black young adults with overweight have higher levels of fasting insulin and systolic blood pressure (Norman et al., 2003). These factors partially contribute to black males' greater likelihood to die from chronic diseases such as diabetes and CVD compared to white males (Gilbert et al., 2016; D. R. Williams, 2008). Moreover, during young adulthood, the amount of physical activity performed by black men significantly decreases and they report significant increases in the amount of calories consumed, both of which lead to weight gain (C. E. Lewis et al., 1997). Qualitative research demonstrates that young adult African-American men engage in little food acquisition and preparation, and the women in their lives largely influence their dietary habits (Lucan, Barg, Karasz, Palmer, & Long, 2012). Further, they prefer foods that are convenient, such as fast food (Lucan, Barg, & Long, 2010). When combined with the evidence demonstrating poor dietary and physical activity behaviors and associated health outcomes among young adult men as a whole, it is unsurprising that there have been numerous calls for research on developing effective behavioral weight control programs specifically for young African-American men (Baker et al., 2014; Kumanyika, Whitt-Glover, & Haire-Joshu, 2014; M. C. Nelson, Story, et al., 2008; Newton, Griffith, Kearney, & Bennett, 2014; Pagoto et al., 2012; Young, Morgan, Plotnikoff, Callister, & Collins, 2012).

## Weight Control Interventions for Young Adult Men

Given that little is known about what is effective for young adult men specifically, studies that exclusively recruited men from a wide age range (e.g., 18-65 years) can provide some insight on effective behavioral weight control strategies for men. For example, systematic reviews demonstrate that when men are successfully enrolled into mixed-sex weight control programs, they tend to lose an equivalent or greater amount of weight compared to women (Bottorff et al., 2015; Newton et al., 2014; R. L. Williams, Wood, Collins, & Callister, 2015), suggesting that these programs can be effective for both sexes. Similarly, numerous reviews have shown that male-only weight control programs produce positive results (Ashton, Hutchesson, Rollo, Morgan, & Collins, 2014; Ashton, Morgan, et al., 2015; Bottorff et al., 2015; Robertson, Douglas, Ludbrook, Reid, & van Teijlingen, 2008; Young et al., 2012). For example, Young et al. (2012) conducted a systematic review of 23 weight control interventions with exclusively male samples aged 18-65 years and report that effective interventions were characterized by increased frequency of face-to-face contact in groups and an energy deficit prescription. Moreover, a smaller meta-analysis of seven RCTs from this review concluded that intervention participants lost an average of 5.66 kg more than control participants (Young et al., 2012). However, researchers note there is a need for higher quality research in men, as current studies are short in duration and have small samples, which could be attributed to difficulties in recruitment (Ashton et al., 2014; Ashton, Morgan, et al., 2015; Bottorff et al., 2015; Pagoto et al., 2012; Robertson et al., 2008; Young et al., 2012). In sum, it appears that men as a whole are able to successfully lose weight when they are enrolled in weight control programs. The larger issue seems to be successfully recruiting men, particularly young men, into these programs.

The evidence base for effective weight control interventions in African-American men is significantly more limited, especially for young African-American men (Kumanyika et al., 2014). For example, the authors of a systematic review of the effectiveness of the Diabetes Prevention Program translations among African-Americans in a variety of settings (e.g., churches, primary care offices) could not generalize their findings to men because they were so underrepresented in the reviewed studies (samples were approximately 90% women on average) (Samuel-Hodge et al., 2014). Another recent systematic review of 14 behavioral weight control studies in this population identified only two studies with a low risk of design-related bias, such as the Weight Loss Maintenance trial (Newton et al., 2014; Svetkey et al., 2008). Moreover, African-American males were the exclusive sample in only four studies (Newton et al., 2014). Three of these four studies had a high risk of bias, as they were quasi-experimental pre-post studies (Hooker, Harmon, Burroughs, Rheaume, & Wilcox, 2011; Stephens et al., 2008; Treadwell et al., 2010). The only reviewed randomized controlled trial showed that tailored telephone education improved reported fruit and vegetable consumption compared to a control group, but did not report any weight outcomes (Wolf, Lepore, Vandergrift, Basch, & Yaroch, 2009). Among young adults, a systematic review focused on lifestyle interventions for weight gain prevention found that 17 of the 18 studies reporting participants' racial characteristics recruited samples that were predominantly white, with 74% of participants identifying as white on average (Lam, Partridge, & Allman-Farinelli, 2015), further limiting the generalizability of findings from these studies to young adult racial/ethnic minorities. Taken together, the underrepresentation of African-American men, particularly young men, in weight control programs limits our understanding of effective approaches for this at-risk group.

Recruitment of young adult men and ethnic minorities is clearly a widespread problem in weight control studies. Systematic reviews have confirmed this notion (Pagoto et al., 2012; Young et al., 2012), noting that average study samples in the lifestyle weight loss literature are composed of 27% men and 2% minority men (Pagoto et al., 2012). Among young adults, one systematic review of recruitment strategies for 26 weight gain prevention studies targeting young adults reported 10 studies that exclusively recruited females and an additional 14 studies that enrolled more female than male participants, with female participants comprising a minimum of 40% and a maximum of 98% of mixed-sex study samples (Dennis, Potter, Estabrooks, & Davy, 2012; Gokee LaRose, Tate, Gorin, & Wing, 2010; Lam et al., 2015). This led the authors to caution against generalization of their results to young adult men (Lam et al., 2015). To improve generalizability, there is a pressing need to understand why young adults, especially men and racial/ethnic minorities, are so underrepresented in weight control studies.

## Weight Misperception, Contextual Factors, and Weight Control in Young Adults

Numerous reasons have been offered to explain why men are underrepresented in weight control research compared to women. In general, evidence suggests that men do not attach as much significance to the appearance of their bodies as women (McCabe & Ricciardelli, 2004). Women report higher levels of body dissatisfaction than men across the lifespan, which acts as a motivational catalyst for attempting weight loss (Fiske, Fallon, Blissmer, & Redding, 2014; McCabe & Ricciardelli, 2004; Sarwer, Thompson, & Cash, 2005; Tiggemann, 2004). Further, qualitative research demonstrates that men of all ages view weight loss as a feminine activity (de Souza & Ciclitira, 2005; Sabinsky et al., 2007). Men also experience less societal pressure to lose weight than women, which may contribute to their underrepresentation in weight control research (Pagoto et al., 2012; Sypeck, Gray, & Ahrens, 2004). However, it is important to note that body dissatisfaction increases among men from adolescence to young adulthood and is associated with increased BMI (Bucchianeri, Arikian, Hannan, Eisenberg, & Neumark-Sztainer, 2013). The cause of this body dissatisfaction varies by weight status. Specifically, young men with overweight/obesity report body dissatisfaction because they desire reduced body fat and increased muscle tone, whereas normal weight and underweight young men report body dissatisfaction because they have a desire to gain weight (i.e., muscle) (Lanoye, Gorin, & LaRose, 2016; McCabe & Ricciardelli, 2004). This desire to gain weight may be the result of sociocultural pressures to exhibit the ideal male muscular body shape (Dallesasse & Kluck, 2013; McCabe & Ricciardelli, 2004). Relatedly, young men tend to misperceive their weight as being underweight or "about the right weight," express less concern about weight gain, and have to experience greater weight gains than women to become concerned about their weight (Cluskey & Grobe, 2009; Dorsey, Eberhardt, & Ogden, 2009; D. S. Ford & Goode, 1994; Gokee LaRose, Gorin, Clarke, & Wing, 2011). Overall, this evidence has led several authors to propose that men of all ages are not as motivated to lose weight as women (Pagoto et al., 2012). The high prevalence of weight misperception among young men may partially explain their lack of motivation (Lanoye et al., 2016; Wardle, Haase, & Steptoe, 2006).

The challenges in enrolling young adult men in weight control programs, and engaging them in weight control behaviors in general, could be partially explained by their beliefs and perceptions about what is considered a healthy weight and their perceived susceptibility to developing obesity. The Health Belief Model (HBM) suggests individuals must believe there is a possibility of experiencing a certain health outcome, the consequences of this outcome could be severe, and that they would benefit from changing their behavior (Champion & Skinner, 2008). In line with the HBM, weight misperception has been proposed as a potential barrier to engagement in weight control behaviors for men of all ages because it reduces perceived susceptibility and may mitigate perceived severity. For example, Duncan et al. (2011) found that men who misperceived their weight were 60% less likely to try to lose weight and 71% less likely to want to lose weight than men who accurately perceived their weight status. Notable sex and racial differences also exist in weight misperception. Studies have consistently shown men are more likely to misperceive their weight than women (Chang & Christakis, 2003; Dorsey et al., 2009; Gregory, Blanck, Gillespie, Maynard, & Serdula, 2008; Gross, Gary, Browne, & LaVeist, 2005; Kuchler & Variyam, 2003; Lemon, Rosal, Zapka, Borg, & Andersen, 2009). For example, a study by Dorsey et al. (2009) observed a significant difference between men and women in weight misperception, with 49% of men with overweight perceiving themselves to be "underweight" or "about the right weight" compared to 22% of women with overweight categorizing themselves in the same way. Similarly, studies have consistently observed that African-American men are more likely to misperceive their weight than white men (Bennett & Wolin, 2006; Dorsey et al., 2009; Dorsey, Eberhardt, & Ogden, 2010). For example, Bennett and Wolin (2006) found that black men with overweight or obesity had a significantly higher odds of misperceiving their weight than white men. Men who misperceive their weight are also less likely to meet physical activity recommendations, with the strongest results found in black men (Duncan et al., 2011). In sum, there is clear evidence for race and sex differences in weight misperception, which could partially explain the underrepresentation of men and African-American men, in particular, in weight control programs.

However, given that these findings are not stratified by age and young adult men are underrepresented in weight control trials, little is known about how weight misperception may influence attempted weight control in young adult men specifically. This lack of information is concerning because weight misperception has increased significantly among young adult men over time. In a comparison of NHANES data from 1988-1994 and 1999-2004, Johnson-Taylor et al. (2008) identified a 13% decrease in accurate weight status perception among men aged 20-34, the largest decrease among all male age groups. Using the same time periods, Burke et al. (2010) also observed a higher misperception rate among men aged 35 years and under in 1999-2004, leading the authors to suggest that this generational shift in perception may make people less inclined to engage in weight control behaviors. Further, research demonstrates self-reported ideal weight has increased among young people from 1987 to 2001, particularly among men (Kuk et al., 2009). Investigating the association between weight loss attempts and perceived weight accuracy among young adults with overweight/obesity using nationally representative data, such as NHANES, may help provide insight into why young adults are notoriously difficult to enroll in weight control programs. Examining differences in this association by sex and race could also improve our understanding of why young men, and African-American men, are particularly challenging to enroll.

As noted earlier, beyond weight misperception, certain contextual factors may be influential in young adults' poor enrollment in weight control programs. However, there is limited evidence investigating the influence of these factors among young adults, particularly young adult men. The broader weight loss literature notes that factors such as education level predict retention and success in weight loss trials (Fabricatore et al., 2009; Moroshko, Brennan, & O'Brien, 2011). Annual income is also known to influence health-related behaviors among young adults, as they may be less likely to focus on the long-term health benefits of weight control if they have more pressing financial demands (M. C. Nelson, Lust, Story, & Ehlinger, 2008; M. C. Nelson, Story, et al., 2008; Walsh, White, & Kattelmann, 2014; Wardle & Steptoe, 2003). Further, young men in particular have reported occupational demands (i.e., working longer hours) as a significant predictor of diet-related behaviors (Pelletier & Laska, 2012). It is well established that all of these factors can be a source of stress for young adults (Arnett, 2000, 2007; Lanoye et al., 2016; M. C. Nelson, Lust, et al., 2008), perhaps leading to a lack of interest in weight control. Young adults are also especially vulnerable to poor mental health (Voelker, 2004), which impacts weight control behaviors (M. C. Nelson, Kocos, et al., 2009). Moreover, African-Americans are more likely than whites to experience these potential barriers to weight control (Kumanyika et al., 2014; Newton et al., 2014). Alternatively, a family history of diabetes or CVD may be an important motivating factor for weight control among young adults, particularly for men (Hunt, Davison, Emslie, & Ford, 2000; Ponder, Lee, Green, & Richards, 1996). Taken together, weight misperception and contextual factors could be influential in young adults' underrepresentation in weight control programs.

## Aims and Hypotheses

Given the relative dearth of studies focused on why young adult men, particularly African-American men, do not enroll in weight control programs, it is imperative to investigate the factors associated with their poor enrollment. Examining these factors could provide insight into why young adult men are underrepresented in weight control programs and may offer suggestions for potential targets to improve recruitment. Weight misperception has been proposed as one factor leading to the poor initiation of weight loss behaviors among men relative to women (Duncan et al., 2011). Thus, Aim 1 of this dissertation is to examine sex differences in the influence of weight status perception accuracy on weight loss attempts in young adults with overweight/obesity. Specifically, it is hypothesized that (1a) weight status perception accuracy will be significantly associated with weight loss attempts among young adults and (1b) sex will moderate the association between weight status perception accuracy and weight loss attempts. Aim 2 is to examine racial differences in the influence of weight status perception accuracy on weight loss attempts in young adult men with overweight/obesity. Specifically, it is hypothesized that (2a) weight status perception accuracy will be significantly associated with weight loss attempts among young adult men and (2b) race will moderate the association between weight status perception accuracy and weight loss attempts. Evidence also suggests certain contextual factors may act as motivators or barriers to attempting weight loss. Thus, Aim 3 is to explore the association between specific contextual factors (i.e., income status, education, depressive symptoms, occupational demands, and family medical history) -- along with weight status perception accuracy -- to determine the strongest predictors of weight loss attempts.

# CHAPTER 2

# METHODS

## Study Design and Population

The National Health and Nutrition Examination Survey (NHANES) is an annual survey of the health and nutritional status of the civilian, non-institutionalized US population conducted by the National Center of Health Statistics. The survey consists of questionnaires administered in the participant's home and a physical examination in the Mobile Examination Center (MEC). Data from the 2007-2014 survey cycles were used because it is the most recent data available. These publicly available, deidentified data are released as 2-year cycles (i.e., 2007-2008, 2009-2010, etc.), meaning that four sets of cross-sectional data spanning eight years are utilized in this study.

The NHANES utilizes a stratified, multi-stage probability sampling technique to provide a sample representative of the US population. Certain groups, including African-Americans, are oversampled to produce reliable statistical estimates. The sample for this study was limited to non-pregnant African-American and white young adults with overweight/obesity between the ages of 20-39 years. Participants who identified as Hispanic or a race other than white or African-American were excluded because the primary thrust of this study is to understand why young adult African-American men are challenging to enroll in weight control programs, particularly given their high obesity risk and known weight-related health disparities compared to men who are non-Hispanic white (Gilbert et al., 2016; Kumanyika et al., 2014; Newton et al., 2014). Further, only participants with overweight/obesity are analyzed because these are the individuals who are in need of weight loss interventions, but may not enroll in them because of weight misperception. Young adults were the focus of this study because of their pronounced weight status misperception (M. A. Burke et al., 2010; Johnson-Taylor et al., 2008) and because this period has been identified as a crucial time to modify weight-related behaviors among those who have overweight/obesity (M. C. Nelson, Story, et al., 2008). Young adulthood was defined as 20-39 years of age because the NHANES Analytic Guidelines recommend utilizing this age range due to the sample design (Johnson et al., 2013), and because it aligns with previous analyses of NHANES data (Beydoun & Wang, 2010; Bleich et al., 2009; Saydah et al., 2013).

## Measures

### *Demographics*

Key demographic variables assessed in NHANES include the participant's sex, age, race, education level, and income status. Specifically, education is assessed by asking, "What is the highest grade or level of school you have completed or the highest degree you have received?" Responses are: Less than 9$^{th}$ grade, 9-11$^{th}$ grade (includes 12$^{th}$ grade with no diploma), High school graduate/GED equivalent, Some college or associate degree, or College graduate or above. Due to a small proportion of the study population reporting less than a 9$^{th}$ grade education, this variable was recoded into the following categories: Less than a High School Graduate, High School Graduate, Some College, or College Graduate and above. Family income to poverty ratio was used to measure income status. Specifically, the family (or individual) income is divided by the Department of Health and Human Services poverty guidelines for the specific survey year. This is a continuous variable with a range of values from 0-5.00. An income status below one means that a family or individual is below the official definition of poverty. An income status of one or greater indicates that a family or individual is above the poverty level.

*Anthropometrics*

Height and weight are objectively measured in the MEC by trained researchers using a calibrated stadiometer and scale, respectively. BMI is then calculated by taking the participant's weight in kilograms divided by their height in meters squared. Overweight and obesity are defined according to clinical guidelines ("Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee," 1995). Specifically, participants with a measured BMI between 25.0-29.9 kg/m$^2$ are classified as having overweight and participants with a measured BMI greater than or equal to 30.0 kg/m$^2$ are classified as having obesity.

*Weight Status Perception Accuracy*

The Weight History Questionnaire assesses weight status perception with the item, "Do you consider yourself to be…" with responses "Overweight," "Underweight," or "About the right weight." A weight status perception accuracy variable was created using this item and participants' measured BMI. In this sample, which was restricted to those with overweight or obesity, participants are classified as having a weight misperception if they report perceiving themselves as "underweight" or "about the right weight" when their measured BMI indicates they have overweight or obesity.

*Occupational Demands*

The Occupation Questionnaire assesses the participants' number of hours worked. If participants report working at a job or business they are then asked "How many hours did you work last week at all jobs or businesses?" Participants respond with the number of hours, making this a continuous variable. If a participant did not report working at a job or business, their response was coded as zero.

### *Depressive Symptoms*

The Mental Health Questionnaire used in NHANES is the Patient Health Questionnaire (Kroenke, Spitzer, & Williams, 2001; Spitzer, Kroenke, & Williams, 1999), which is a valid and reliable (Cronbach $\alpha$=0.86) (Kroenke et al., 2001) nine item questionnaire that screens for depressive symptoms over the past two weeks. Each item starts with the prompt, "Over the last 2 weeks, how often have you been bothered by the following problems..." Example items include, "little interest or pleasure in doing things?" and "feeling down, depressed, or hopeless?" Responses are scored on a 0-3 scale and include, "Not at all," "Several days," "More than half the days," or "Nearly every day." Item responses are summed to create a total depression severity score from 0 to 27. Score ranges for depression severity are as follows: 0-4=Minimal, 5-9=Mild, 10-14=Moderate, 15-19=Moderately severe, 20-27=Severe (Kroenke et al., 2001). These ranges have both high construct and criterion validity (Kroenke et al., 2001).

### *Family Medical History*

The Medical Conditions Questionnaire assesses participants' reported health conditions. Two items from this questionnaire are included in the analyses to address a family history of CVD and diabetes. Each item begins with the prompt, "Including living and deceased, were any of your biological, that is, blood relatives including father, mother, sisters or brothers, ever told by a health professional..." The CVD item asks, "...that they had a heart attack or angina before the age of 50?" The diabetes item asks, "...that they had diabetes?" Participants can respond "Yes" or "No" to these items.

### *Weight Loss Attempts*

The primary outcome is a composite binary measure of weight loss attempts in the past year. Combining responses from two items on the Weight History Questionnaire created this measure. Specifically, if participants self-report a weight from one year ago that is ten pounds or more than their self-reported current weight they are asked item (1), "Was the change between your current weight and your weight a year ago intentional?" If a participant does not meet this criterion or responds "No" to this item, they are asked item (2), "During the past 12 months, have you tried to lose weight?" Participants who responded "Yes" to item (1) were not asked item (2), so duplication of participant responses is not a concern. Responses to item (1) are combined with responses to item (2) to create the weight loss attempts primary outcome.

## Analytic Plan

### *Data Management*

Data from the 2007-2014 survey cycles were downloaded from the NHANES website (http://www.cdc.gov/nchs/nhanes/index.htm) and variables of interest were appended and merged into a single dataset. The analytic guidelines provided by the National Center for Health Statistics were followed in all analyses. Analyses were conducted on weighted NHANES data using Stata/IC 14.2 svyset and svy procedures to account for the complex sampling design. Analyses account for the complex sample design by constructing an appropriate sample design weight according to the analytic guidelines (Johnson et al., 2013). NHANES provides two sample design-weighting variables for analyses: an interview weighting variable and a MEC weighting variable. Given that measured height and weight from the MEC will be used in the present study, it is recommended that the MEC weighting variable is used to allow for estimates to be appropriately adjusted for the complex survey design (including oversampling of certain populations), non-response, and post-stratification. This enables generalizability of findings to the US non-institutionalized civilian population. Sampling errors were estimated by using the provided primary sampling units and strata and calculated through Taylor series linearization. Associations are identified as statistically significant at the alpha <0.05 level.

Prior to conducting analyses focused on primary aims, univariate descriptive statistics were run to provide the basic study sample characteristics and assess the amount of missing data. Individual associations between the continuous and categorical predictor variables and the weight loss attempts outcome variable were assessed with study design-based t-tests and Pearson chi-square tests, respectively. Given that NHANES focuses on population estimates, means are displayed with standard errors instead of standard deviations.

### *Aim 1 Analyses*

Separate unadjusted logistic regression models tested the two hypotheses for Aim 1. To test hypothesis 1a that weight status perception accuracy is significantly associated with weight loss attempts among young adults, a logistic regression examined the association between weight status perception accuracy and weight loss attempts in the past year. Given the desire to understand potential differences by sex on weight loss attempts, analyses included both male and female black and white young adults with overweight/obesity. To test hypothesis 1b a separate logistic regression was run to determine if sex moderates the association between weight status perception accuracy and weight loss attempts. Specifically, weight status perception accuracy and sex were entered into the model as predictors along with a participant sex by weight status perception accuracy interaction term. Weight loss attempts was the outcome variable.

*Aim 2 Analyses*

Analyses for Aim 2 focused specifically on young adult men. Separate unadjusted logistic regression models were run to test the two hypotheses for Aim 2. To test hypothesis 2a that weight status perception accuracy is significantly associated with weight loss attempts among young adult men, a logistic regression was run with weight status perception accuracy as the predictor variable and weight loss attempts in the past year as the outcome variable. To test hypothesis 2b a logistic regression model determined if race moderates the association between weight status perception accuracy and weight loss attempts. Specifically, weight status perception accuracy and race were entered into the model as predictors along with a participant race by weight status perception accuracy interaction term with weight loss attempts as the outcome variable.

*Aim 3 Analyses*

According to initial t-tests and chi-squared tests, factors that were significantly associated with weight loss attempts ($p<0.05$) were entered into the fully adjusted model for Aim 3. Specifically, models created to test the first and second aim were then adjusted for significant contextual factors to determine the effect of weight status perception accuracy and contextual factors on weight loss attempts, in addition to potential moderation by sex or race, among young adults with overweight/obesity. The first fully adjusted model examined the effect of weight status perception accuracy and contextual factors on weight loss attempts among young adults. Specifically, the following variables were entered into this model: participant sex, weight status perception accuracy, the sex by weight status perception accuracy interaction term, and contextual factors that were significantly associated with weight loss attempts. The second model examined the effect of weight status perception accuracy and the contextual factors on weight loss attempts among young adult men. Specifically, the following variables were entered into the model: participant race, weight status perception accuracy, the race by weight status perception accuracy interaction term, and contextual factors significantly associated with reported weight loss attempts. Odds ratios in each fully adjusted model were inspected to determine the specific influence of each factor on weight loss attempts.

### *Missing Data*

All questionnaire items included in the analyses allow participants to respond, "don't know" or refuse to respond. These responses were treated as missing data, per the NHANES analytic guidelines (Johnson et al., 2013). If more than 10% of the data is missing for an item, the NHANES analytic guidelines recommend multiple imputation of data (Johnson et al., 2013). According to preliminary analyses, 14% of the data were missing for the depressive symptoms variable. Thus, multiple imputation by chained equations (MICE) was employed in analyses for Aim 3. MICE was selected because it allows for imputation of variables that must take on specific values, such as a binary outcome variable, as is the case in this study. It is important that the imputation model is consistent with the analytic model to maintain congeniality (i.e., the imputation and analytic models are compatible with one another) (White, Royston, & Wood, 2011). Accordingly, all variables included in the regression model for Aim 3 must undergo MICE, even if they are missing a small amount of data. White et al. (2011) recommend that the number of imputations should be at least greater than the percentage of missing data in the analysis. To adhere to this recommendation, 15 imputations were completed. Imputed data were only utilized in analyses for Aim 3.

### *Sensitivity Analyses*

Participants with a BMI bordering the overweight cut point could be misclassified as having an inaccurate weight status perception due to small differences in weight. Given that excess weight gain occurs gradually over time, it is unlikely that individuals will immediately perceive their change from normal weight to overweight. As a result, there may be a discrepancy between perception and measured weight that misclassifies participants. For example, a 5’9” individual who weighs 168 lbs. has a BMI of 24.8 kg/m$^2$, which places him in the normal weight category. If this individual gains two pounds, he now weighs 170 lbs. and his BMI is 25.1, meaning he now has overweight. To account for potential misclassification caused by a slight weight status misperception and/or measurement error when heights and weights were obtained, sensitivity analyses were conducted with a higher BMI cut point. Analyses were limited to participants with a measured BMI of 27.0 kg/m$^2$. As above, participants who consider themselves “Underweight” or “About the right weight” were classified as misperceiving their weight. The models for all three aims were recreated with this new weight misperception variable to ensure stability of results.

# CHAPTER 3

# RESULTS

## Characteristics of the Study Population

Overall characteristics of non-pregnant black and white young adults with overweight/obesity are listed in Table 1. Approximately 63% of the population identified as non-Hispanic white and over half were male. The mean age was 30 years (*SE*=0.16) and the mean BMI was 32.1 kg/$m^2$ (*SE*=0.17). About 60% of the sample had at least some college education. Approximately 12% of participants reported having a close relative that had a heart attack and 38% reported a close relative being diagnosed with diabetes. Mean number of hours worked in the past week was 31 (*SE*=0.62), and mean income status was 2.78 (*SE*=0.07), indicating an average income 278% above the poverty threshold. Participants reported a mean depressive score of 3.19 (*SE*=0.09) indicating minimal depressive symptoms on average. Approximately 31% of participants had an inaccurate weight status perception (i.e., did not recognize that they had overweight or obesity). Most (58%) participants reported a weight loss attempt in the past year.

Table 1

*Overall Characteristics of non-Pregnant White and Black Young Adults with Overweight/Obesity (N=2756)*

| Characteristic | Percent | Count |
|---|---|---|
| Race | | |
| Non-Hispanic White | 62.5 | 1723 |
| Non-Hispanic Black | 37.5 | 1033 |
| Sex | | |
| Male | 51.4 | 1417 |
| Female | 48.6 | 1339 |
| Age (years), *M* (*SE*) | 30.3 (0.16) | |
| Income Status, *M* (*SE*) | 2.78 (0.07) | |
| Education Level | | |
| < High School Graduate | 14.5 | 399 |
| High school graduate | 25.1 | 692 |
| Some college | 38.1 | 1051 |
| College graduate or above | 22.2 | 611 |
| BMI (kg/m$^2$), *M* (*SE*) | 32.1 (0.17) | |
| Weight Status | | |
| Overweight | 44.2 | 1218 |
| Obese | 27.5 | 758 |
| Obese Class II | 15.3 | 421 |
| Obese Class III | 13.0 | 359 |
| Close Relative had a Heart Attack | | |
| Yes | 11.6 | 320 |
| No | 86.3 | 2378 |
| Close Relative had Diabetes | | |
| Yes | 38.3 | 1056 |
| No | 59.9 | 1652 |
| Number of Hours Worked Last Week, *M* (*SE*) | 30.7 (0.62) | |
| Depression Score (Range 0-27), *M* (*SE*) | 3.19 (0.09) | |
| Weight Status Perception | | |
| Overweight | 69.2 | 1907 |
| About the Right Weight | 29.6 | 816 |
| Underweight | 1.1 | 29 |
| Weight Status Perception Accuracy | | |
| Inaccurate | 30.7 | 845 |
| Accurate | 69.2 | 1907 |
| Weight Loss Attempt in the Past Year | | |
| Yes | 58.3 | 1608 |
| No | 41.6 | 1146 |

*Note.* Unweighted percentages and counts are shown unless noted otherwise. Percentages may not sum to 100% and counts may not sum to *N* because of missing data. *M*=Mean; *SE*=Standard Error

## Aim 1 – The Effect of Weight Status Perception Accuracy and Sex on Weight Loss Attempts Among Young Adults

Descriptive comparisons by sex are displayed in Table A1 (Appendix). Compared to male participants, more female participants reported a weight loss attempt in the past year ($F$[1, 64]=66.1, $p$<0.01) and accurately perceived their weight ($F$[1, 64]=151.0, $p$<0.01). In support of Hypothesis 1a, weight status perception accuracy was significantly associated with weight loss attempts. Young adult participants with overweight/obesity who had an accurate perception of their weight had 4.57 higher odds of reporting a weight loss attempt compared to those with an inaccurate weight status perception (*OR*=4.57; *CI* 3.83-5.44; $p$<0.01). Logistic regression results that assessed whether sex moderated the association between weight status perception accuracy and reported weight loss attempts among white and black young adults with overweight/obesity are displayed in Table 2. Despite differences by sex noted above, moderation by sex was not detected. Analyses demonstrated a significant main effect for weight status perception accuracy (*OR*=3.66; *95% CI* 2.80-4.77; $p$<0.01), but no main effect for sex (*OR*=1.27; *95% CI* 0.83-1.96; $p$=0.27), nor a significant weight status perception accuracy by sex interaction (*OR*=1.36; *95% CI* 0.79-2.33; $p$=0.26; Figure 1). Thus, Hypothesis 1b was not supported.

Table 2

*The Effect of Weight Status Perception Accuracy and Sex on Weight Loss Attempts Among White and Black Young Adults with Overweight/Obesity (n=2751)*[a]

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Sex | | | | |
| Male | Reference | --- | --- | --- |
| Female | 1.27 | 0.83 | 1.96 | 0.27 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 3.66 | 2.80 | 4.77 | <0.01 |
| Weight Status Perception Accuracy x Sex | 1.36 | 0.79 | 2.33 | 0.26 |

[a] Five participants were missing data for either weight status perception accuracy, weight loss attempts, or both.

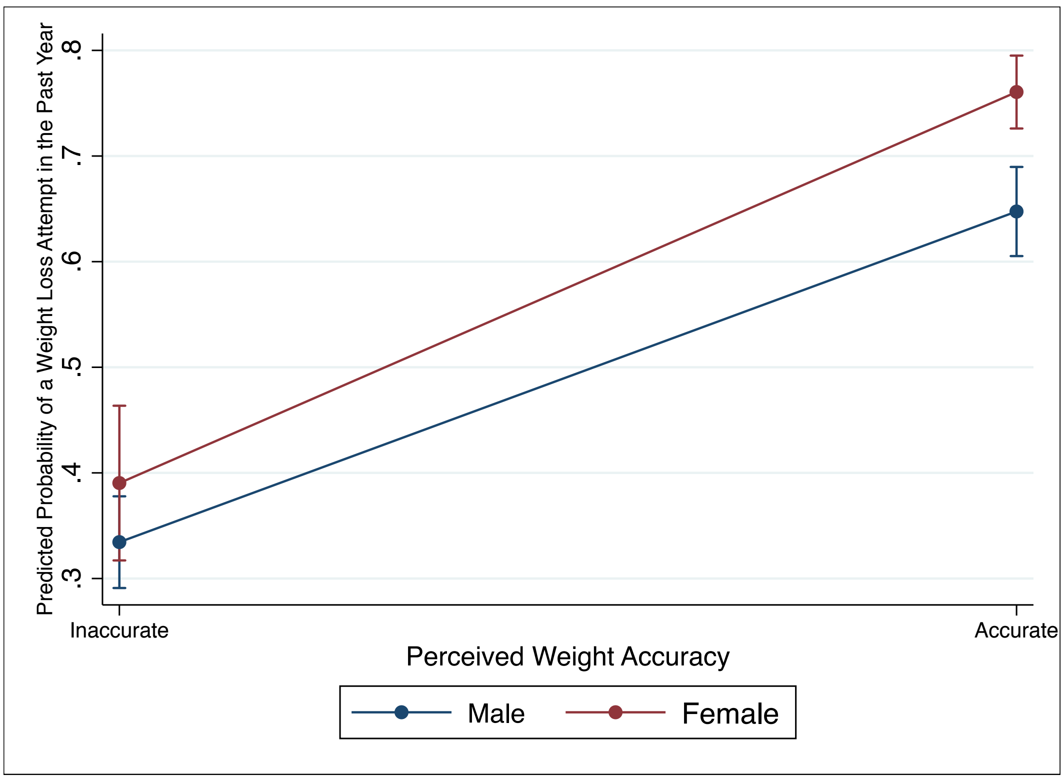


Figure 1. The Association between Weight Status Perception Accuracy and Sex on Weight Loss Attempts Among Young Adults with Overweight/Obesity

Aim 2 – The Effect of Weight Status Perception Accuracy and Race on Weight Loss Attempts Among Young Adult Males

Descriptive comparisons by race are displayed in Table A2. Compared to white male participants, fewer black male participants had an accurate weight status perception ($F[1, 64]=24.6$, $p<0.01$). However, there was no significant difference between black and white male participants in reporting a weight loss attempt in the past year ($F[1, 64]=0.00$, $p=0.97$). Weight status perception accuracy was significantly associated with weight loss attempts, which supports Hypothesis 2a. Specifically, male participants with an accurate weight status perception had 3.66 higher odds of reporting a weight loss attempt compared to those with an inaccurate weight status perception (*OR*=3.66; *95% CI* 2.80-4.77; $p<0.01$). Logistic regression results that assessed whether race moderated the association between weight status perception accuracy and weight loss attempts among white and black young adult men with overweight/obesity are displayed in Table 3. Although fewer African American males accurately perceived their weight than non-Hispanic white males, there was no moderation by race. As can be seen in Table 3 and Figure 2, a main effect for weight status perception accuracy was observed (*OR*=3.73; *95% CI* 2.76-5.03; $p<0.01$). There was no main effect for race (*OR*=1.23; *95% CI* 0.83-1.82; $p=0.30$), nor a significant weight status perception accuracy by race interaction (*OR*=0.99; *95% CI* 0.59-1.68; $p=0.98$; Figure 2). Thus, Hypothesis 2b was not supported.

Table 3

*The Effect of Weight Status Perception Accuracy and Race on Weight Loss Attempts Among White and Black Young Adults Men with Overweight/Obesity (n=1415)*[a]

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Race | | | | |
| White | Reference | --- | --- | --- |
| Black | 1.23 | 0.83 | 1.82 | 0.30 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 3.73 | 2.76 | 5.03 | <0.01 |
| Weight Status Perception Accuracy x Race | 0.99 | 0.59 | 1.68 | 0.98 |

[a] Two participants were missing data for weight status perception accuracy.

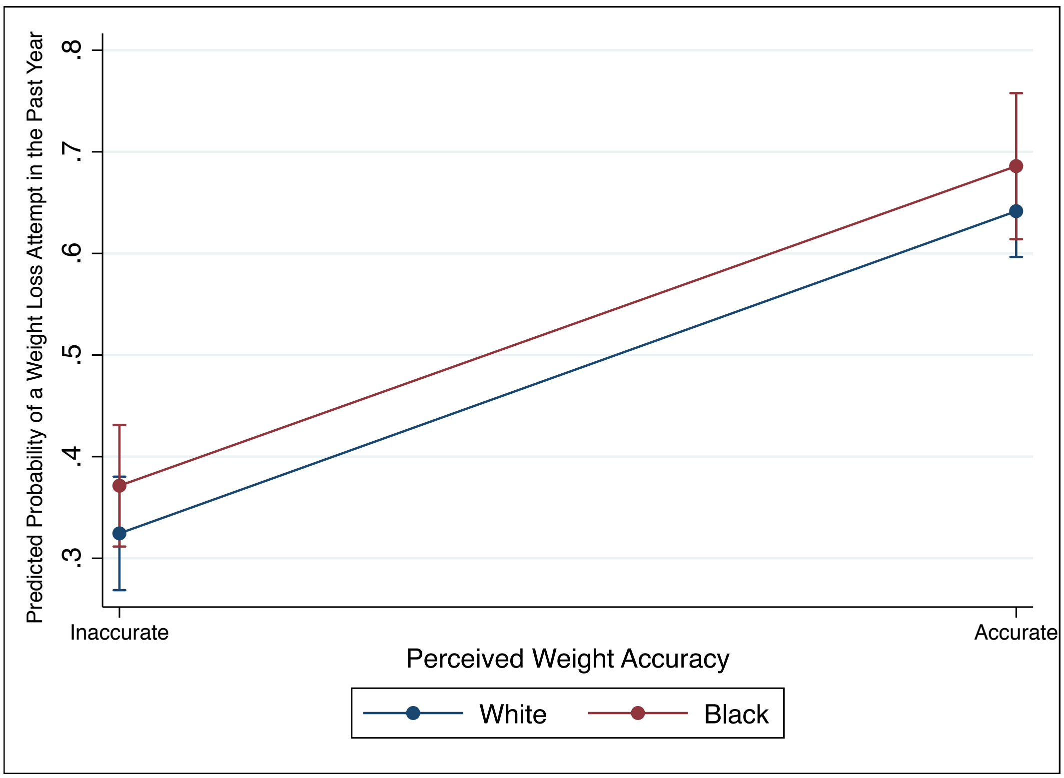


Figure 2. The Association between Weight Status Perception Accuracy and Race on Weight Loss Attempts Among Young Adult Men with Overweight/Obesity

## Aim 3 – The Effect of Weight Status Perception Accuracy and Contextual Factors

### *Differences by Sex Among Black and White Young Adults with Overweight/Obesity*

Table A3 displays results from preliminary Pearson chi-squared tests and t-tests for categorical and continuous predictor variables of interest, respectively, with the weight loss attempts outcome for black and white young adults with overweight/obesity. Participants with higher education levels were more likely to report a weight loss attempt compared to those who with lower education levels ($F[2.59, 165.8]=10.9$, $p<0.01$). In addition, participants with higher mean income status ($t[64]=2.83$, $p=0.01$) and higher mean depressive symptoms ($t[64]=3.04$, $p<0.01$) were more likely to report a weight loss attempt than those with lower income and depressive symptoms, respectively. No other contextual factors were associated with weight loss attempts, however, models controlled for BMI because it was significantly associated with a weight loss attempt. Education level, income status, and depressive symptoms were included in a logistic regression model for all young adults for Aim 3. Due to a large amount of missing data for depressive symptoms, data were multiply imputed by chained equations.

Table 4 displays results from the logistic regression model including the gender and weight status perception accuracy predictor variables and interaction term in addition to the significant contextual factors for all black and white young adult participants with overweight/obesity. Whereas preliminary models (Table A3) examined each variable independently, variables were entered simultaneously into this model. There was a significant main effect for weight status perception accuracy with those participants reporting an accurate weight status perception having 3.19 greater odds of reporting a weight loss attempt than those with an inaccurate weight status perception (*OR*=3.19; *95% CI* 2.38-4.29; $p<0.01$). Participants with some college education or greater had significantly higher odds of reporting a weight loss attempt than participants with less than a high school education. Income status was also significantly associated with reporting a weight loss attempt, indicating that a higher income status is associated with higher odds of reporting a weight loss attempt (*OR*=1.11; *95% CI* 1.04-1.19; $p<0.01$). Neither sex nor depressive symptoms were significantly associated with reporting a weight loss attempt. Consistent with findings from Aim 1, sex did not moderate the association between weight status perception accuracy and weight loss attempts in this fully adjusted model.

Table 4

*The Effect of Weight Status Perception Accuracy and Contextual Factors on Weight Loss Attempts Among White and Black Young Adults with Overweight/Obesity (n=2756)*[a]

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Sex | | | | |
| Male | Reference | --- | --- | --- |
| Female | 1.42 | 0.93 | 2.17 | 0.10 |
| Education Level | | | | |
| < High School Graduate | Reference | --- | --- | --- |
| High School Graduate | 1.17 | 0.88 | 1.56 | 0.29 |
| Some College | 1.60 | 1.18 | 2.17 | <0.01 |
| College Graduate | 1.95 | 1.39 | 2.72 | <0.01 |
| Income Status | 1.11 | 1.04 | 1.19 | <0.01 |
| Depressive Symptoms | 1.02 | 0.99 | 1.05 | 0.09 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 3.19 | 2.38 | 4.29 | <0.01 |
| Weight Status Perception Accuracy x Sex | 1.24 | 0.73 | 2.10 | 0.42 |

*Note.* Analyses controlled for BMI.

[a] Due to >10% missing data for depressive symptoms, multiple imputation by chained equations was used on all variables.

*Differences by Race Among Black and White Young Adult Men with Overweight/Obesity*

Table A4 displays results from preliminary Pearson chi-squared tests and t-tests for categorical and continuous predictor variables of interest, respectively, with the weight loss attempts outcome for black and white young adult men with overweight/obesity. The findings closely matched those from the larger sample. As with the larger sample of young adults, significantly more male participants with higher levels of education reported a weight loss attempt compared to those who did not report a weight loss attempt ($F$[2.55, 163.5]=6.47, $p$<0.01). Similarly, those with higher mean income status ($t$[64]=2.84, $p$=0.01) and higher mean depressive symptoms ($t$[64]=2.57, $p$=0.01) reported a weight loss attempt compared to those who did not report a weight loss attempt. No other contextual factors were associated with weight loss attempts. Education level, income status, and depressive symptoms were included in a logistic regression model for Aim 3.

Table 5 displays results from logistic regression models including the race and weight status perception accuracy predictor variables and interaction term, as well as the significant contextual factors for black and white young adult male participants with overweight/obesity. The results were largely consistent with the larger sample of young adults. There was a significant main effect for weight status perception accuracy with those male participants reporting an accurate weight status perception having 3.10 greater odds of reporting a weight loss attempt than those with an inaccurate weight status perception (*OR*=3.10; *95% CI* 2.18-4.41; $p$<0.01). Participants with some college education or greater had significantly higher odds of reporting a weight loss attempt than participants with less than a high school education. Income status was also significantly associated with reporting a weight loss attempt, indicating that a higher income status is associated with higher odds of reporting a weight loss attempt (*OR*=1.10; *95% CI* 1.02-1.20; $p$=0.02). These analyses also revealed a significant association between depressive symptoms and reporting a weight loss attempt, indicating that higher depressive symptoms are associated with higher odds of reporting a weight loss attempt

($OR$=1.06; *95% CI* 1.02-1.10; $p$=0.01). There was not a significant main effect for race. Consistent with findings from Aim 2, race did not moderate the association between weight status perception accuracy and weight loss attempts.

Table 5

*The Effect of Weight Status Perception Accuracy and Contextual Factors on Weight Loss Attempts Among White and Black Young Adult Men with Overweight/Obesity (n=1417)*[a]

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Race | | | | |
| White | Reference | --- | --- | --- |
| Black | 1.38 | 0.93 | 2.06 | 0.11 |
| Education Level | | | | |
| < High School Graduate | Reference | --- | --- | --- |
| High School Graduate | 1.28 | 0.84 | 1.95 | 0.24 |
| Some College | 1.85 | 1.25 | 2.74 | <0.01 |
| College Graduate | 2.44 | 1.61 | 3.72 | <0.01 |
| Income Status | 1.10 | 1.02 | 1.20 | 0.02 |
| Depressive Symptoms | 1.06 | 1.02 | 1.10 | 0.01 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 3.10 | 2.18 | 4.41 | <0.01 |
| Weight Status Perception Accuracy x Race | 0.95 | 0.54 | 1.64 | 0.84 |

*Note.* Analyses controlled for BMI.

[a] Due to >10% missing data for depressive symptoms, multiple imputation by chained equations was used on all variables.

## Sensitivity Analyses

Sensitivity analyses were conducted with a higher BMI cut point of 27 kg/m$^2$ to adjust for the potential undue influence of participants with a slight weight misperception on study outcomes. Logistic regression results for the effect of weight status perception accuracy on weight loss attempts among all white and black young adults and among men specifically are displayed in Tables A5 and A6, respectively. Table A7 displays results from fully adjusted logistic regression models for the sensitivity analyses among all black and white young adult participants. Table A8 displays results from fully adjusted logistic regression models for black and white young adult male participants. As can be seen in the Tables, findings were largely consistent with the main analyses, except for a significant main effect for race in the fully adjusted model for young adult men (*OR*=1.78; *95% CI* 1.09-2.89; *p*=0.02).

# CHAPTER 4

# DISCUSSION

## Summary of Findings

In an effort to determine why young adult men, particularly African-American men, are less likely to enroll in weight control programs, the present study aimed to determine whether sex and race moderated the association between weight status perception accuracy and weight loss attempts in young adults with overweight or obesity. The influence of additional pertinent contextual factors on weight loss attempts was also explored. Findings from the present study partially support the study aims and indicate that, in a nationally representative sample, weight status perception accuracy was significantly associated with reports of weight loss attempts in the past year. Sixty-nine percent of young adults with overweight or obesity accurately perceived their weight status. Further, differences were observed by sex for both weight status perception accuracy and weight loss attempts, with men reporting lower accuracy and decreased likelihood to initiate weight loss efforts within the past year. However, sex did not moderate the relationship between weight status perception accuracy and weight loss attempts among young adults. Additional contextual factors, including higher education level and higher income status were significantly associated with weight loss attempts.

Analyses focused on determining potential racial differences among young adult men with overweight/obesity were largely consistent. Weight status perception accuracy was significantly associated with reporting a weight loss attempt in the past year. However, as with sex, race did not moderate the relationship between weight status perception accuracy and weight loss attempts among young adult men. Higher education level, income status, and depressive symptoms were also found to be significantly associated with weight loss attempts in these analyses. To my knowledge, this is the first study to examine sex and race as potential moderators of the association between weight status perception accuracy and weight loss attempts among young adults with overweight/obesity using a large, generalizable sample. As a whole, findings indicate that regardless of sex or race weight status perception accuracy is a significant predictor of whether or not a young adult reports attempting to lose weight.

## Associations Between Weight Status Perception Accuracy and Weight Loss Attempts Among Young Adult Men and Women with Overweight/Obesity

As noted above, most young adults with overweight/obesity had an accurate perception of their weight status. This finding aligns with studies conducted with adult populations of all ages, which demonstrated that most people with overweight/obesity accurately perceive their weight status (Bennett & Wolin, 2006; Dorsey et al., 2009; Duncan et al., 2011). Further, the majority of young adults in this study reported a weight loss attempt in the past year, a finding that is also supported by the broader adult literature (Nicklas, Huskey, Davis, & Wee, 2012; Serdula et al., 1999). Taken together, these findings are potentially promising because they demonstrate that most young adults with overweight/obesity are aware of their weight status and report attempting to lose weight. However, despite promising overall findings, it is important to note significant differences by sex suggesting that young adult men may be less aware of their weight status and less likely to engage in weight loss than young adult women. Specifically, and 52% of men compared to 82% of women had an accurate weight status perception while 51% of young men reported a weight loss attempt in the past year compared to 67% of young women in the present study. Although not surprising given extant literature with adults as a whole (Bennett & Wolin, 2006; Chang & Christakis, 2003; Dorsey et al., 2009;

Kuchler & Variyam, 2003; Lemon et al., 2009 (Bish et al., 2005; Kruger, Galuska, Serdula, & Jones, 2004; Lemon et al., 2009), and young adults more specifically (Gross et al., 2005; LaRose et al., 2016), it underscores the need for an increased focus on young adult men in future research, as many appear to be unaware they have overweight/obesity and are not engaging in weight control efforts, potentially placing them at risk for developing a number of significant comorbidities.

Although important differences by sex were observed for weight perception accuracy and attempted weight loss, sex did not moderate the association between accuracy and reported weight loss attempt. Rather, regardless of sex, participants with an accurate weight status perception were approximately four times as likely to report a weight loss attempt compared to those with an inaccurate weight status perception. Findings are consistent with those from studies conducted with a broader age range of adults. Specifically, previous studies found that adults with a weight status misperception were less likely to engage in weight control behaviors (Duncan et al., 2011; Lemon et al., 2009; Lynch et al., 2009). For example, among a broader adult population, Duncan et al. (2011) found that men and women with overweight/obesity who misperceived their weight were 60% less likely to have tried to lose weight in the past year. Findings from the present study not only parallel those with the broader adult literature, but also are consistent with studies that assessed weight status perception accuracy in young adults (LaRose et al., 2016; Wardle et al., 2006). For example, Wardle, Haase, and Steptoe (2006) found that 20% of women and 50% of men with overweight/obesity had an inaccurate weight status perception. However, these studies did not assess associations between weight status perception accuracy and weight control behaviors. Thus, the present study builds upon this previous work by demonstrating that weight status perception accuracy is significantly associated with weight loss attempts among young adults with overweight/obesity.

In spite of this significant association, the absence of moderation by sex suggests that unmeasured factors other than weight perception accuracy may account for sex differences in weight loss attempts and thus the underrepresentation of young men in behavioral weight control programs. For example, body image dissatisfaction may explain why significantly more women than men had an accurate weight status perception in the present study. Women are more likely to report body image dissatisfaction than men (Sarwer et al., 2005; M. B. Schwartz & Brownell, 2004), a sex difference which may be driven by Western sociocultural norms and expectations for women to be thin (Furnham, Badmin, & Sneade, 2002; Myers & Crowther, 2007). As a result of this body image dissatisfaction, women with overweight/obesity may appear to have a more "accurate" weight status perception than men simply because they are more likely to perceive themselves as having overweight/obesity, regardless of actual BMI. Given that body image dissatisfaction can motivate weight loss (Sarwer et al., 2005), this may explain the sex differences in weight loss attempts observed in the present study. Further, young men believe weight loss is a feminine activity, are less concerned about weight gain, and have to experience larger weight gains than women to become concerned about their weight (Cluskey & Grobe, 2009; de Souza & Ciclitira, 2005; Gokee LaRose et al., 2011; Sabinsky et al., 2007). All of these factors in combination may consequently explain why women are more likely than men to enroll in behavioral weight control programs (Pagoto et al., 2012).

Evidence suggests that these commonly held beliefs by young men might be overcome by modifying recruitment strategies and program designs. For example, simple strategies such as using the word "Men" in advertisements may enhance enrollment of young men (Crane, LaRose, Espeland, Wing, & Tate, 2016). Recruitment materials could also capitalize on the finding that young adult men with overweight/obesity report disease prevention as a stronger motivating factor for enrolling in a weight control program compared to their female counterparts (LaRose et al., 2016). In addition, several recent studies have shown that men of all ages prefer to enroll in programs that are simplified, self-directed, and primarily delivered through the Internet (Crane, Lutes, Ward, Bowling, & Tate, 2015; Young et al., 2017). Qualitative research indicates that young adults also prefer these program components (LaRose et al., 2016). Taken together, these findings suggest these recruitment strategies and program components should be tested specifically in young adult men to determine if it improves enrollment in behavioral weight control programs.

## Associations Between Weight Status Perception Accuracy and Weight Loss Attempts Among Black and White Young Adult Men with Overweight/Obesity

In analyses focused on young adult men, we found that fewer young adult black men with overweight/obesity accurately perceived their weight status compared to their white counterparts. Specifically, 49% of black young adult men accurately perceived their weight status compared to 62% of white young adult men. As with above, this finding is consistent with studies with adults of all ages (Bennett & Wolin, 2006; Dorsey et al., 2009). However, the present study builds upon these findings by extending them specifically to young adult men and African-American men, groups that are typically understudied.

Although differences in weight perception accuracy were observed, the present study did not find a significant difference between black and white young men with overweight/obesity in reporting a weight loss attempt nor significant moderation by race in the association between weight status perception accuracy and weight loss attempts. Rather, weight status perception accuracy was an important predictor of reporting a weight loss attempt, regardless of race. In contrast, previous research in adults of all ages found that weight status misperception differentially impacts the likelihood of reporting a weight loss attempt among black and white men with overweight/obesity (Dorsey et al., 2010; Duncan et al., 2011). Specifically, black men with overweight/obesity who misperceived their weight status were 22% less likely to report a weight loss attempt than their white male counterparts (Duncan et al., 2011). The non-significant findings in the present study may be anomalous because analyses were limited to young adult men. Racial differences may become more pronounced later in life.

Taken together, findings were unable to shed light on why young black men are less likely to engage in weight control efforts. Thus, there is a continued need to understand why young black men do not enroll in weight control programs. This is particularly important given their high risk for excess weight gain during young adulthood and subsequent poor health outcomes (G. L. Burke et al., 1996; Cluskey & Grobe, 2009; Huang et al., 2003; T. F. Nelson et al., 2007; Norman et al., 2003; Racette et al., 2008). Given the absence of moderation by race, factors other than weight status perception accuracy may account for the challenges in enrolling young adult black men in weight control programs. Future research could examine other factors, such as body image and sociocultural norms as they may offer some explanation for their underrepresentation.

Evidence suggests that young African-American men have a more positive body image and are less anxious about their appearance than white young men (Ricciardelli, McCabe, Williams, & Thompson, 2007; Russell, 2002). As with differences by sex, a positive body image rather than weight status misperception may explain why young African-American men reported being “about the right weight” to the weight status perception question. It is likely that an individual will give this response if he feels satisfied with his weight and body shape; especially given the stigma attached to the term “overweight” (Brochu & Esses, 2011; Puhl, Peterson, & Luedicke, 2013). Weight status misperception is also highly prevalent among men with overweight/obesity who lack the stereotypical markers of overweight/obesity (e.g., high waist circumference, arm fat) (D. W. Lewis, Dutton, & Affuso, 2015). The absence of these markers is associated with a more positive body image, particularly for young black men (Gross et al., 2005). Consequently, the higher prevalence of weight status misperception among young black men with overweight/obesity compared to their white counterparts observed in the present study may partially reflect a more positive body image among African-Americans.

Sociocultural norms may also play a role in the racial differences in weight status perception accuracy among young men observed in the present study. Obesity is known to spread through social networks, which is thought to influence weight-related behaviors and perceptions of what is considered “about the right weight,” particularly among young people (M. A. Burke et al., 2010; Christakis & Fowler, 2007; Leahey, Gokee LaRose, Fava, & Wing, 2011; Maximova et al., 2008; Neighbors & Sobal, 2007). It is hypothesized that social norms partially account for this spread (Christakis & Fowler, 2007). For example, research with adolescents demonstrates that underestimation of weight status increases in concert with higher reported BMIs in parents and schoolmates (Maximova et al., 2008). The weight status of peers and significant others may be especially influential to young adults’ perceptions, given the increased importance of these groups compared to parents during young adulthood (Fraley & Davis, 1997; M. C. Nelson, Story, et al., 2008).

Similarly, research demonstrates that African-American males have a preference for larger body sizes, a belief that may be transmitted to them by their parents and bolstered by low peer pressure to be thin (Ricciardelli et al., 2007). Evidence also suggests that young African-American men perceive larger body sizes to be healthier and are less likely to experience stigma for having overweight/obesity than white young men (Aruguete, Nickleberry, & Yates, 2004; Bennett et al., 2006; Hebl & Turchin, 2005; Kumanyika et al., 2014). Taken together, these findings suggest that overweight/obesity may be part of a sociocultural norm among young African-American men, which may explain their higher prevalence of weight status misperception in the present study and their more positive body image, as described above. These factors could lead to decreased likelihood of attempting weight loss or enrolling in weight control programs.

To address under-enrollment among young African-American men in behavioral weight control programs it may be necessary to adopt new recruitment messages that focus on health and disease prevention. This notion is not too dissimilar from the ideas proposed above for enhancing enrollment of young adult men more generally, and is based on a number of factors. For example, male young adults and African-Americans report that their decision to enroll in a research study is motivated by preventing disease and whether they or a relative has the disease of interest (Byrd et al., 2011; LaRose et al., 2016). Further, research grounded in the Health Belief Model has shown that African-Americans view a reduced risk of health problems as a perceived benefit of weight loss (James, Pobee, Oxidine, Brown, & Joshi, 2012). These findings suggest that emphasizing prevention of the comorbidities associated with overweight/obesity could be an effective message for improving enrollment young African-American men in weight control programs. Using messaging that focuses on comorbidities that are disproportionately high among African-Americans, such as diabetes, may be an especially effective strategy for recruiting this group.

## Associations Between Contextual Factors and Weight Loss Attempts Among Black and White Young Adults with Overweight/Obesity

Beyond accuracy of weight perception, certain contextual factors also emerged as significant predictors of reported weight control in the past year. Specifically, reporting some college education or higher and higher income status were each significantly associated with higher odds of reporting a weight loss attempt. These findings are consistent with the broader adult weight loss literature (Jeffery & French, 1996; Kakinami, Gauvin, Barnett, & Paradis, 2014; O'Brien, Whitaker, Yu, & Ackermann, 2015; Serdula et al., 1999). Well-educated and wealthy individuals likely have higher levels of health literacy and numerical skills, and better access to healthy foods and physical activity facilities, all of which help promote weight loss attempts (Cavanaugh et al., 2008; Wardle & Steptoe, 2003). Among young adults, high financial strain and credit card debt are significantly associated with low levels of physical activity, excess sedentary behavior, and unhealthy weight control practices (M. C. Nelson, Lust, et al., 2008; VanKim & Laska, 2012). It is important to note that the present study also observed significant racial differences between young men in education and income status, with African-American men reporting lower education levels and income than white men. Extensive research supports these findings and further notes the intense societal and environmental pressures placed on young black men that may decrease their motivations to change health behaviors (Gilbert et al., 2016). These factors are important to consider, albeit challenging to address, when designing recruitment strategies and developing programs.

Neither occupational demands (i.e., number of hours spent working in the past week) nor family medical history were associated with reporting a weight loss attempt. The former finding was unexpected; qualitative research suggests that lack of time is one of the most commonly reported barriers to weight control behaviors among college students (Greaney et al., 2009; Linde et al., 2014; M. C. Nelson, Kocos, et al., 2009) and broader samples of young adults (LaRose et al., 2016). It is possible that, in isolation, the occupational demands construct in the present study did not adequately capture the multifaceted nature of the competing demands for time that may impact young adults' weight loss attempts. As the developmental literature notes, emerging and young adults are in a stage of their life with numerous changes, where they may take on many responsibilities, such as school and family care (Arnett, 2000, 2007). These responsibilities may take time away from pursuing weight control (M. C. Nelson, Story, et al., 2008), and are not assessed by NHANES so could not be analyzed in the present study. Future research should attempt to disentangle which time demands are the most significant barriers to attempting weight control for young adults with overweight/obesity, as this could inform intervention development.

Similarly, there was no evidence in the present study that reporting that a close relative experienced a heart attack or was diagnosed with diabetes was associated with reporting a weight loss attempt. Although this finding may seem contrary to what would be theoretically supported by the Health Belief Model (i.e., perceived susceptibility to and severity of a disease and its comorbidities will increase an individual's likelihood of taking actions to avoid that disease) (Champion & Skinner, 2008), it adds to the mixed findings to date. For example, an analysis of CARDIA data found that young adult participants with a family member who experienced a heart attack were not more likely to change their physical activity behaviors or weight compared to participants without a family member who had experienced this health event (Kip, McCreath, Roseman, Hulley, & Schreiner, 2002). Alternatively, Hunt et al. (2000) found that young adults with a family history of heart disease were more likely to endorse attitudes promoting exercise than their peers without a family history of heart disease. Young adults also report an increased vulnerability to diabetes if they had a relative affected by it (Ponder et al., 1996). The absence of a significant finding in the present study and mixed findings to date suggest that a family history of a heart attack or diabetes may not be the most salient health event to prompt weight loss among young adults with overweight/obesity. Future research should explore which health events may be more salient to young adults with overweight/obesity and the event's association with subsequent weight-related behaviors.

Although not significant in the larger analyses, in those analyses focused on young adult men, depressive symptoms were also associated with weight loss attempts. Specifically, for every one-unit increase in depressive symptoms, young adult men were 6% more likely to report a weight loss attempt. However, it is important to note that depressive symptoms as a whole in this sample were in the mild range. It is therefore unclear what these slight elevations might reflect. It is possible that this measure could be capturing factors related to depression, such as general distress. For example, high distress in social situations is known to lead to weight loss in male college students (Economos, Hildebrandt, & Hyatt, 2008). In addition, the weight loss attempts variable in this study does not distinguish between specific types of weight control, such as healthy and unhealthy practices. It is possible that this variable could be capturing some unhealthy weight control behaviors, given one study suggesting that depressive symptoms are associated with unhealthy weight control practices in young adult men (Davila et al., 2014).

However, as with the present study, the Davila et al. study was cross-sectional and the sample reported low levels of depressive symptoms, so these findings should be cautiously interpreted.

In sum, weight status perception accuracy and certain contextual factors have a clear influence on weight loss attempts among young adults with overweight/obesity, and should be considered during efforts to enroll young adults in weight control programs. Given consistency in findings across both sex and race as well as lack of evidence that either factor moderates the association between weight status perception accuracy and weight loss attempts, more research is needed to determine what may explain sex and race differences in weight loss attempts among young adults. Such efforts could shed light on effective strategies to be employed to improve representation of young adult men, especially African-American men, in weight control programs.

## Strengths and Limitations

This study has numerous strengths. NHANES is a large dataset with a complex survey design that allows for results from this study to be generalized to the US population of young adults who are black or white and overweight/obese. This overcomes a limitation of some previous studies with young adults that have been conducted with relatively homogeneous college-based populations (D. S. Ford & Goode, 1994; Gillen & Lefkowitz, 2012; Gross et al., 2005; M. C. Nelson, Kocos, et al., 2009). Moreover, this study utilized objectively measured BMI, which provides a better estimate of weight status than self-reported BMI among young adults (Danubio, Miranda, Vinciguerra, Vecchi, & Rufo, 2008). The use of contemporary data is another strength. Research suggests that weight misperception has increased over time and is especially pronounced among young adults (M. A. Burke et al., 2010; Johnson-Taylor et al., 2008). Using contemporary data provides a clearer picture of both how weight status misperception and contextual factors are currently related to weight loss attempts in this population. Further, sensitivity analyses were conducted to protect against the undue influence of participants with a slight weight status misperception and were consistent with the primary findings. The present study is also novel in its examination of moderation by race and sex in the association between weight status perception accuracy and weight loss attempts to better understand why young men, especially young African-American men, do not enroll in weight control programs.

These results should also be considered in light of the present study's limitations. The cross-sectional nature of this study does not allow causal inferences to be made about the association between weight status perception accuracy or the contextual factors and weight loss attempts. In fact, participants reported retrospectively on weight loss attempts. As a result, this study cannot conclude that these factors actually lead to attempting weight loss.

Further, there may be other variables that may confound the significant associations observed in the present study, but are not assessed by NHANES. For example, body image is not measured in NHANES, but has a clear association with weight status perception and weight control (McCabe & Ricciardelli, 2004; Tiggemann, 2004). Previous studies have also shown a significant association between stress and weight change behavior in young adults (Economos et al., 2008; M. C. Nelson, Lust, et al., 2008). However, stress is not assessed in NHANES and thus could not be examined in this study. In addition, complex factors such as time demands and financial strain could not be fully accounted for in the present study, yet appear particularly relevant to weight control among young adults given their developmental stage (Lanoye et al., 2016; LaRose et al., 2016; M. C. Nelson, Story, et al., 2008). Only one aspect of time demands, number of hours worked in the past week, was assessed in the present study. Other time demands, such as time spent at school, may affect young adults' weight loss attempts. Whether or not a participant is currently in school and time spent there are not assessed in NHANES, so this additional time demand could not be analyzed. Financial strain and income status are related but conceptually distinct constructs. In previous studies financial strain was measured by asking an individual to report how difficult it is to live on his household income (VanKim & Laska, 2012). In the present study income status was measured using the family income to poverty ratio, which compares reported family (or individual) income to federal poverty guidelines. Thus, income status may not adequately capture individual-level financial experiences, which can be in flux during young adulthood.

This study only included young adults with overweight/obesity because it is recommended these individuals attempt weight loss to lower their risk of weight-related comorbidities (Jensen et al., 2014). Participants from other racial/ethnic groups were excluded because the purpose of this study was to understand why young adult African-American men are challenging to enroll in weight control programs, despite known health disparities. Therefore, these results cannot be generalized to those who are underweight/normal weight or those from excluded racial/ethnic groups.

Last, one contextual factor was missing a significant amount of data so multiple imputation was necessary to conduct analyses for Aim 3. Multiple imputation can introduce bias if not correctly applied (Sterne et al., 2009). To minimize bias, the analyses in this study were conducted with and without multiply imputed data and the results were consistent, suggesting robust effects.

## Future Research Directions

Findings from the present study do not help to determine why men are less likely to enroll in weight control programs than women. However, there are several promising avenues to explore to improve enrollment of young adult men, particularly African-Americans, in weight control programs. For example, previous research suggests that young adult men may be more receptive to weight control programs emphasizing physical activity, specifically resistance training, given their noted desire to build muscle (Baghurst, Hollander, Nardella, & Haff, 2006; Dallesasse & Kluck, 2013; Drewnowski & Yee, 1987; Lanoye et al., 2016; McCabe & Ricciardelli, 2004). Yet, a recent systematic review could not identify any randomized controlled trials that tested a physical activity intervention in young men exclusively (Ashton, Morgan, et al., 2015). This could be because physical activity alone is not sufficient to promote clinically significant weight loss. However, given physical activity's potential appeal to young men and its noted cardio-metabolic benefits (Bottorff et al., 2015; Donnelly et al., 2003; Lee et al., 2012; Sigal et al., 2014), future research should consider integrating novel physical activity components into behavioral weight control programs to see if it increases enrollment from this group.

CBPR may also be a fruitful strategy for reaching young African-American men. To specifically reach African-American men of all ages, diabetes prevention programs have proposed partnering with male leaders in the community and recruiting via personal appeals at social and fraternal organizations and barbershops, for example (Newton et al., 2015). Numerous studies, including the present one, have also shown there are significant racial disparities in income and education between white and black young adults (Braveman, Cubbin, Egerter, Williams, & Pamuk, 2010; Wang & Beydoun, 2007). Fortunately, CBPR has also been used to effectively enroll disadvantaged young adults in weight control programs (Linde et al., 2014; Walsh et al., 2014). Future studies should examine if these CBPR approaches are effective in recruiting young black men for weight control programs, especially those from disadvantaged backgrounds, as they are likely among those at greatest risk for poor health outcomes. Program implementation should also be examined in these studies to determine if CBPR overcomes known retention and adherence challenges among young adults (Laska et al., 2016; Nitzke et al., 2007; Walsh, Kattelmann, & White, 2017).

Another testable approach to enrolling young adults in weight control programs may be to target the behavioral components of weight control within the framework of salient contextual factors, such as financial management. Young adults struggle with financial management as they establish their independence, which can be a source of stress, and lead to poor weight-related behaviors (Arnett, 2000, 2007; Lanoye et al., 2016; M. C. Nelson, Lust, et al., 2008; M. C. Nelson, Story, et al., 2008; Pelletier & Laska, 2012; VanKim & Laska, 2012). Given these challenges faced by young adults, some have suggested that programs could emphasize healthy meals that are not expensive to prepare (Lanoye et al., 2016; Pelletier & Laska, 2012). Research suggests that young adults want weight control programs that are more comprehensive and address a variety of stressful factors (Corsino et al., 2013; LaRose et al., 2016). Moreover, programs advertised as “comprehensive lifestyle interventions” instead of “weight loss interventions” may be able to more effectively enroll young adults, especially men, with overweight/obesity who misperceive their weight status, but know they struggle with financial management, for example. This is a proposal worthy of future research.

Given that weight status perception accuracy was such a strong predictor of reported weight loss attempts, it would be helpful to better understand the determinants of weight status perception accuracy. Previous research indicates that perception of weight status is likely influenced by body image and sociocultural norms, among other factors. Future studies could disentangle race and sex differences in specific body image constructs, such as weight and body shape satisfaction, weight desires, and ideal weight to determine how these constructs affect weight status perception accuracy. As mentioned above, overweight/obesity tends to cluster in social networks, specifically in young adults, and social norms are thought to partially account for this clustering (Christakis & Fowler, 2007; Leahey et al., 2011). Determining the associations between social norms and weight status perception accuracy, as well as potential race and sex differences, may inform recruitment efforts for behavioral weight loss programs that attempt to leverage social networks to improve outcomes. Finally, evidence suggests that perceived health status moderates the association between perception of healthy weight and BMI among black men (Godino, Lepore, & Rassnick, 2010). Future research could explore racial differences in this association among young men, particularly in light of research demonstrating that young black men believe larger body sizes are healthy (Aruguete et al., 2004; Bennett et al., 2006).

The present study also found that approximately one-third of black and white young adults with overweight/obesity had an inaccurate perception of their weight status. These young adults are significantly less likely to report a weight loss attempt than their counterparts who accurately perceive their weight status. To prompt initiation of weight loss among those who misperceive their weight status, others have proposed that healthcare professionals should consider correcting inaccurate weight status perceptions (Duncan et al., 2011; Yaemsiri, Slining, & Agarwal, 2011). Indeed, cross-sectional research indicates that individuals with overweight/obesity are more likely to report a weight loss attempt if a healthcare professional acknowledges their weight status (Pool et al., 2014; Post et al., 2011).

There is a well-studied parallel in the pediatric obesity literature that exposes some potential limitations of correcting a weight status misperception. It is well established that parents underestimate their child's weight status (Eckstein et al., 2006; Lundahl, Kidwell, & Nelson, 2014). School-based BMI screening and surveillance conducted by school employees and subsequent delivery of BMI report cards to parents were proposed as an intervention to correct this misperception. However, systematic reviews indicate that the effectiveness of BMI report cards is quite mixed, possibly trending toward less effective and potentially harmful for children with overweight/obesity (Almond, Lee, & Schwartz, 2016; Evans & Sonneville, 2009; Ruggieri & Bass, 2015). Given additional research suggesting that young adults who perceive themselves as having overweight/obesity are more likely to gain weight and exhibit disordered eating behaviors (Sonneville, Thurston, Milliren, Gooding, & Richmond, 2016; Sonneville, Thurston, Milliren, Kamody, et al., 2016), future research should consider the relative utility of clinic-based interventions designed to correct a weight status misperception among young adults with overweight/obesity. In sum, there are several promising directions for future research that could enhance our understanding of weight status perception accuracy and how to improve enrollment of young adult men and African-Americans in behavioral weight loss programs.

## Conclusion

Findings from the present study demonstrate that most young adults accurately perceived their weight, and this, in turn, was significantly associated with reporting a weight loss attempt. However, neither sex nor race moderated the association between weight status perception accuracy and weight loss attempts. Thus, the present findings cannot speak to why young adult men, and specifically African American men, are less likely to enroll in weight control programs. However, they underscore the importance of weight status perception accuracy in whether young adults with overweight and obesity attempt weight loss. Future research should attempt to further disentangle the associations between weight status perception accuracy, contextual factors, and weight control among young adults. Other constructs should also be explored as they may better explain race and sex differences in weight status perception accuracy and weight control.

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APPENDIX A

Descriptive Tables

Table A1

*Comparisons by Sex of non-Pregnant White and Black Young Adults with Overweight/Obesity (N=2756)*

| Characteristics | Males (n=1417) | Females (n=1339) | *p*-value |
|---|---|---|---|
| Race | | | <0.01 |
| Non-Hispanic White | 944 (66.6) | 779 (58.2) | |
| Non-Hispanic Black | 473 (33.4) | 560 (41.8) | |
| Age (years), M (SE) | 30.4 (0.18) | 30.2 (0.21) | 0.32 |
| Income Status, *M (SE)* | 3.08 (0.07) | 2.45 (0.09) | <0.01 |
| Education Level | | | <0.01 |
| < High School Graduate | 200 (14.1) | 199 (14.9) | |
| High school graduate | 395 (27.9) | 297 (22.2) | |
| Some college | 491 (34.7) | 560 (41.8) | |
| College graduate or above | 329 (23.2) | 282 (21.1) | |
| BMI ($kg/m^2$), *M (SE)* | 31.1 (0.20) | 33.2 (0.22) | <0.01 |
| Weight Status | | | <0.01 |
| Overweight | 708 (50.0) | 510 (38.1) | |
| Obese | 399 (28.2) | 359 (26.8) | |
| Obese Class II | 186 (13.1) | 235 (17.6) | |
| Obese Class III | 124 (8.8) | 235 (17.6) | |
| Close Relative had a Heart Attack | | | <0.01 |
| Yes | 135 (9.5) | 185 (13.8) | |
| No | 1246 (87.9) | 1132 (84.5) | |
| Close Relative had Diabetes | | | <0.01 |
| Yes | 496 (35.0) | 560 (41.8) | |
| No | 891 (62.9) | 761 (56.8) | |
| Number of Hours Worked Last Week, *M (SE)* | 35.4 (0.84) | 25.5 (0.83) | <0.01 |
| Depression Score (Range 0-27), *M (SE)* | 2.53 (0.11) | 3.94 (0.15) | <0.01 |
| Weight Status Perception | | | <0.01 |
| Overweight | 814 (44.4) | 1093 (55.6) | |
| Underweight | 18 (54.7) | 11 (45.3) | |
| About the Right Weight | 583 (74.1) | 233 (25.9) | |
| Weight Status Perception Accuracy | | | <0.01 |
| Inaccurate | 601 (42.4) | 244 (18.2) | |
| Accurate | 814 (57.5) | 1093 (81.6) | |
| Weight Loss Attempt in the Past Year | | | <0.01 |
| Yes | 716 (50.5) | 892 (66.6) | |
| No | 701 (49.5) | 445 (33.2) | |

*Note.* Unweighted counts (column %) are shown unless noted otherwise. Percentages may not sum to 100% and counts may not sum to *N* because of missing data. *M*=Mean; *SE*=Standard Error

[a] *p*-value is from a design-based Pearson chi-squared test or t-test, as appropriate

Table A2

*Comparisons by Race of White and Black Young Adult Men with Overweight/Obesity (n=1417)*

| Characteristic | White Men (n=944) | Black Men (n=473) | *p*-value[a] |
|---|---|---|---|
| Age (years), *M (SE)* | 30.4 (0.22) | 30.0 (0.23) | 0.17 |
| Income Status, *M (SE)* | 3.21 (0.08) | 2.40 (0.10) | <0.01 |
| Education Level | | | <0.01 |
| < High School Graduate | 124 (13.1) | 76 (16.1) | |
| High school graduate | 249 (26.4) | 146 (30.9) | |
| Some college | 319 (33.8) | 172 (36.4) | |
| College graduate or above | 250 (26.5) | 79 (16.7) | |
| BMI ($kg/m^2$), *M (SE)* | 30.9 (0.23) | 32.5 (0.30) | <0.01 |
| Weight Status | | | <0.01 |
| Overweight | 498 (52.8) | 210 (44.4) | |
| Obese | 268 (28.4) | 131 (27.7) | |
| Obese Class II | 106 (11.2) | 80 (16.9) | |
| Obese Class III | 72 (7.6) | 52 (11.0) | |
| Close Relative had a Heart Attack | | | 0.04 |
| Yes | 106 (11.2) | 29 (6.1) | |
| No | 813 (86.1) | 433 (91.5) | |
| Close Relative had Diabetes | | | <0.01 |
| Yes | 286 (30.3) | 210 (44.4) | |
| No | 636 (67.4) | 255 (53.9) | |
| Number of Hours Worked Last Week, *M (SE)* | 36.7 (0.97) | 28.7 (1.02) | <0.01 |
| Depression Score (Range 0-27), *M (SE)* | 2.52 (0.12) | 2.56 (0.18) | 0.86 |
| Weight Status Perception | | | <0.01 |
| Overweight | 584 (61.9) | 230 (48.6) | |
| Underweight | 7 (0.7) | 11 (2.3) | |
| About the Right Weight | 351 (37.2) | 232 (49.1) | |
| Weight Status Perception Accuracy | | | <0.01 |
| Inaccurate | 358 (37.9) | 243 (51.4) | |
| Accurate | 584 (61.9) | 230 (48.6) | |
| Weight Loss Attempt in the Past Year | | | 0.97 |
| Yes | 469 (49.7) | 247 (52.2) | |
| No | 475 (50.3) | 226 (47.8) | |

*Note.* Unweighted counts (column %) are shown unless noted otherwise. Percentages may not sum to 100% and counts may not sum to *n* because of missing data. *M*=Mean; *SE*=Standard Error

[a] *p*-value is from a design-based Pearson chi-squared test or t-test, as appropriate

Table A3

*Bivariate Associations of Predictor Variables with Weight Loss Attempts Among non-Pregnant White and Black Young Adults with Overweight/Obesity (n=2754)*[a]

| Characteristic | No Weight Loss Attempt (n=1146) | Weight Loss Attempt (n=1608) | *p*-value[b] |
|---|---|---|---|
| Race | | | 0.31 |
| Non-Hispanic White | 718 (41.7) | 1005 (58.3) | |
| Non-Hispanic Black | 428 (41.5) | 603 (58.5) | |
| Sex | | | <0.01 |
| Male | 701 (49.5) | 716 (50.5) | |
| Female | 445 (33.3) | 892 (66.7) | |
| Age (years), *M (SE)* | 30.4 (0.22) | 30.2 (0.19) | 0.45 |
| Income Status, *M* (*SE*) | 2.63 (0.08) | 2.88 (0.08) | 0.01 |
| Education Level | | | <0.01 |
| < High school graduate | 208 (52.1) | 190 (47.6) | |
| High school graduate | 326 (47.1) | 366 (52.9) | |
| Some college | 396 (37.7) | 654 (62.2) | |
| College graduate or above | 214 (35.0) | 397 (65.0) | |
| BMI ($kg/m^2$), *M (SE)* | 30.7 (0.23) | 33.0 (0.23) | <0.01 |
| Close Relative had a Heart Attack | | | 0.07 |
| Yes | 119 (37.2) | 200 (62.5) | |
| No | 1005 (42.3) | 1372 (57.7) | |
| Close Relative had Diabetes | | | 0.20 |
| Yes | 415 (39.3) | 640 (60.6) | |
| No | 711 (43.0) | 940 (56.9) | |
| Number of Hours Worked Last Week, *M* (*SE*) | 30.6 (0.65) | 31.0 (1.05) | 0.71 |
| Depressive Symptoms (Range 0-27), *M* (*SE*) | 2.85 (0.14) | 3.39 (0.11) | <0.01 |
| Weight Status Perception Accuracy | | | <0.01 |
| Inaccurate | 570 (67.5) | 275 (32.5) | |
| Accurate | 574 (30.1) | 1332 (69.9) | |

*Note.* Unweighted counts (row %) are shown unless noted otherwise. Counts may not sum to *n* because of missing data. *M*=Mean; *SE*=Standard Error

[a] Two participants were missing data for weight loss attempts.
[b] *p*-value is from a design-based Pearson chi-squared test or t-test, as appropriate.

Table A4

*Bivariate Associations of Predictor Variables with Weight Loss Attempts among White and Black Young Adult Men with Overweight/Obesity (n=1417)*

| Characteristic | No Weight Loss Attempt (n=701) | Weight Loss Attempt (n=716) | *p*-value[a] |
|---|---|---|---|
| Race | | | 0.97 |
| Non-Hispanic White | 475 (50.3) | 469 (49.7) | |
| Non-Hispanic Black | 226 (47.8) | 247 (52.2) | |
| Age (years), *M* (*SE*) | 30.5 (0.28) | 30.3 (0.22) | 0.46 |
| Income Status, *M* (*SE*) | 2.94 (0.09) | 3.21 (0.08) | 0.01 |
| Education Level | | | <0.01 |
| < High School Graduate | 131 (65.5) | 69 (34.5) | |
| High school graduate | 207 (52.4) | 188 (47.6) | |
| Some college | 225 (45.8) | 266 (54.2) | |
| College graduate or above | 136 (41.3) | 193 (58.7) | |
| BMI ($kg/m^2$), *M* (*SE*) | 29.9 (0.24) | 32. 2 (0.32) | <0.01 |
| Close Relative had a Heart Attack | | | 0.41 |
| Yes | 64 (47.4) | 71 (52.6) | |
| No | 624 (50.1) | 622 (49.9) | |
| Close Relative had Diabetes | | | 0.74 |
| Yes | 242 (48.8) | 254 (51.2) | |
| No | 446 (50.1) | 445 (49.9) | |
| Number of Hours Worked Last Week, *M* (*SE*) | 35.5 (1.25) | 35.3 (0.98) | 0.91 |
| Depressive Symptoms (Range 0-27), *M* (*SE*) | 2.22 (0.16) | 2.79 (0.16) | 0.01 |
| Weight Status Perception Accuracy | | | <0.01 |
| Inaccurate | 410 (68.2) | 191 (31.8) | |
| Accurate | 290 (35.6) | 524 (64.4) | |

*Note.* Unweighted counts (row %) are shown unless noted otherwise. Counts may not sum to *n* because of missing data. *M*=Mean; *SE*=Standard Error

[a] *p*-value is from a design-based Pearson chi-squared test or t-test, as appropriate.

APPENDIX B

Sensitivity Analyses

Table A5

*The Effect of Weight Status Perception Accuracy and Sex on Weight Loss Attempts Among White and Black Young Adults with a Measured BMI ≥ 27 kg/m$^2$ (n=2212)*

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Sex | | | | |
| Male | Reference | --- | --- | --- |
| Female | 1.05 | 0.60 | 1.85 | 0.86 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 3.04 | 2.18 | 4.22 | <0.01 |
| Weight Status Perception Accuracy x Sex | 1.64 | 0.81 | 3.33 | 0.17 |

Table A6

*The Effect of Weight Status Perception Accuracy and Race on Weight Loss Attempts Among White and Black Young Adult Men with a Measured BMI ≥ 27 kg/m$^2$ (n=1095)*

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Race | | | | |
| White | Reference | --- | --- | --- |
| Black | 1.54 | 0.97 | 2.44 | 0.07 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 3.32 | 2.28 | 4.84 | <0.01 |
| Weight Status Perception Accuracy x Race | 0.82 | 0.46 | 1.46 | 0.49 |

Table A7

*The Effect of Weight Status Perception Accuracy and Contextual Factors on Weight Loss Attempts Among White and Black Young Adults with a Measured BMI ≥ 27 kg/m$^2$ (n=2217)*[a]

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Sex | | | | |
| Male | Reference | --- | --- | --- |
| Female | 1.20 | 0.70 | 2.08 | 0.50 |
| Education Level | | | | |
| < High School Graduate | Reference | --- | --- | --- |
| High School Graduate | 1.14 | 0.82 | 1.56 | 0.43 |
| Some College | 1.62 | 1.14 | 2.30 | 0.01 |
| College Graduate | 1.93 | 1.29 | 2.88 | <0.01 |
| Income Status | 1.16 | 1.07 | 1.25 | <0.01 |
| Depressive Symptoms | 1.02 | 0.99 | 1.05 | 0.16 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 2.58 | 1.83 | 3.63 | <0.01 |
| Weight Status Perception Accuracy x Sex | 1.49 | 0.76 | 2.92 | 0.24 |

*Note.* Analyses controlled for BMI.

[a] Due to >10% missing data for depressive symptoms, multiple imputation by chained equations was used on all variables.

Table A8

*The Effect of Weight Status Perception Accuracy and Contextual Factors on Weight Loss Attempts Among White and Black Young Adult Men with a Measured BMI ≥ 27 kg/m$^2$ (n=1097)*[a]

| Variable | Odds Ratio | 95% CI | | *p*-value |
|---|---|---|---|---|
| Race | | | | |
| White | Reference | --- | --- | --- |
| Black | 1.78 | 1.09 | 2.89 | 0.02 |
| Education Level | | | | |
| < High School Graduate | Reference | --- | --- | --- |
| High School Graduate | 1.37 | 0.87 | 2.16 | 0.17 |
| Some College | 1.90 | 1.21 | 3.00 | 0.01 |
| College Graduate | 2.77 | 1.70 | 4.50 | <0.01 |
| Income Status | 1.16 | 1.06 | 1.27 | <0.01 |
| Depression Score | 1.06 | 1.01 | 1.10 | 0.02 |
| Weight Status Perception Accuracy | | | | |
| Inaccurate | Reference | --- | --- | --- |
| Accurate | 2.75 | 1.85 | 4.06 | <0.01 |
| Weight Status Perception Accuracy x Race | 0.79 | 0.43 | 1.44 | 0.44 |

*Note.* Analyses controlled for BMI.

[a] Due to >10% missing data for depressive symptoms, multiple imputation by chained equations was used on all variables.