THE ASSOCIATION BETWEEN PERSONALITY AND SELF-MONITORING, WEIGHT LOSS BEHAVIORS AND TREATMENT OUTCOME

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ABSTRACT

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Obesity is a serious problem that affects nearly two-thirds of U.S. adults. Behavioral interventions that incorporate components on eating, physical activity and behavioral principles are considered the most effective treatment for mild to moderate obesity. While such interventions produce consistent, but modest, weight losses, there is considerable variability in treatment outcomes. Therefore, researchers have been interested in examining individual difference characteristics to identify correlates of successful weight loss. Previous research shows that personality characteristics are associated with health behaviors. However, less is known about their relationship with weight-related behaviors and weight loss. The present study examined how conscientiousness and impulsivity contribute to weight loss behaviors and treatment outcome in a sample of overweight and obese adults. Fifty-two overweight and obese adults participated in an 18 week weight loss program. Results showed no significant relationships between conscientiousness and impulsivity with BMI, weight loss behaviors (e.g., eating and exercise habits, weight loss goals, caloric intake, and energy expenditure), adherence, and weight loss. Results suggest that personality is likely a distal predictor of weight loss behaviors. Future research might instead examine possible mediators of weight loss behaviors and weight loss outcomes. Research in this area is greatly needed, as it would not only optimize the efficacy of treatment, but would allow for better matching between treatment and the individual; thus making treatment both effective and cost-effective.
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INTRODUCTION

Obesity

The prevalence of obesity has increased dramatically in the United States. Recent data indicates that approximately 68% of adults are either overweight or obese, with more than 30% obese (Flegal, Carroll, Ogden, & Curtin, 2010). Obesity is the second leading cause of preventable death in the United States (Kushner, 2006), and is a risk factor for many chronic illnesses such as diabetes, hypertension, dyslipidaemia, stroke, heart disease, certain cancers and osteoarthritis (Guh et al., 2009; Haslam & James, 2005; Malnick & Knobler, 2006).

Furthermore, it poses a significant economic burden; medical care costs associated with obesity were estimated at $147 billion in 2008, double that of 2003 (Centers for Disease Control and Prevention (CDC), 2011b; Wang, 2011). Compared to normal weight individuals, obese individuals incur greater direct medical expenses, with an estimated 46% more on inpatient care, 27% on physician visits and outpatient care and 80% on medication (Wang, 2011). Suffice to say, obesity is a major public health concern and finding cost-effective treatment and prevention programs is critical.

The goal of this paper is to explore the contribution of personality traits to weight loss behaviors and treatment outcome. For a long time, researchers have been interested in whether personality characteristics influence weight-related behaviors and obesity treatment. Being able to identify personality traits would allow for better treatment matching, thus providing both effective and cost-effective treatment. The paper will start with a review of the weight loss literature. This includes a discussion of the sources contributing to obesity (namely, poor diet and lack of activity), the benefits of behavioral treatment, and the challenges facing weight loss treatment. Next, this review discusses strategies found to improve long-term weight loss. This
will be accomplished through an examination of behaviors and strategies reported by those successful at weight loss. Then, one behavioral strategy, self-monitoring, found to be associated with successful weight loss and management will be further investigated. Finally, there will be a review of the personality literature. This includes an overview of the major theory of personality traits, a discussion of past research on the relationship between personality and health and lifestyle behaviors, and its influence on weight and treatment outcome.

Obesity is defined as an excessive amount of fat or adipose tissue (National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), 2012; Romero-Corral et al., 2008). It can be measured by calculating Body Mass Index (BMI), which is the ratio of weight (in kilograms) and height (in meters squared). In adults, a BMI between 25 and 30 is considered overweight, while those with a higher BMI (30 and above) are obese (CDC, 2010; NIDDK, 2012). However, BMI is not a direct measurement of body fat and does not distinguish between fat and muscle (lean mass; CDC, 2010; NIDDK, 2012; Romero-Corral et al., 2008). Despite this limitation, BMI is an easy and inexpensive measurement tool (Seidell, Kahn, Williamson, Lissner, & Valdez, 2001), is moderately correlated with percent body fat (Deurenberg, Weststrate, & Seidell, 1991; Romero-Corral et al., 2008) and may be one of the best ways to evaluate changes in weight over time, as any fluctuations typically represent changes in body fat (Romero-Corral et al., 2008).

Obesity is a result of an energy imbalance between calories consumed and calories expended (CDC, 2011a; NIDDK, 2012; U.S. Department of Agriculture and U.S. Department of Health and Human Services (HHS), December 2010). In order to lose weight, individuals must create a caloric deficit by decreasing total calories consumed and increasing levels of physical activity (CDC, 2011a; HHS, December 2010). According to the Dietary Guidelines for
Americans 2010, in order to maintain a healthy weight, adults should consume foods high in nutrients and low in energy density (HHS, December 2010). Specifically, adults should increase their intake of fruits, vegetables and whole grains, reduce the consumption of sugared beverages, and monitor their calories consumed from alcohol (HHS, December 2010).

Despite these recommendations, most Americans aren’t meeting these guidelines for a healthy diet. Only a fourth of adults eat the recommended 3 or more servings of fruits and vegetables each day (CDC, 2007; Sampsel & May, 2007; HHS, December 2010) and fewer than 3% eat the recommended number of servings from all food groups (Dixon, Cronin, & Krebs-Smith, 2001). Physical inactivity has been cited as another source contributing to this epidemic (CDC, 2011a; HHS, December 2010). While it is recommended that adults engage in 150 minutes of moderate to intense physical activity each week, more than half do not meet these guidelines and 24% are not active at all (CDC, 2008; Sampsel & May, 2007).

In addition to changing dietary intake and physical activity, the National Heart, Lung, and Blood Institute (NHLBI) recommend incorporating behavioral strategies to reinforce healthy habits (Panel, N.O.E.I.E., 1998). These include self-monitoring, stimulus control, goal setting, and problem solving (Panel, N.O.E.I.E., 1998). Together, these lifestyle changes have significant health benefits (Good, Holschuh, Albertson, & Eldridge, 2008; Hill & Kris-Etherton, 2008; Paffenbarger et al., 1993). Two large-scale multisite randomized controlled trials (RCTs), the Diabetes Prevention Program (DPP) and Look AHEAD (Action for Health in Diabetes), have highlighted the long-term benefits of such lifestyle changes.

In the DPP, researchers investigated whether weight loss through intensive lifestyle treatment or medication alone could reduce or delay the occurrence of type 2 diabetes in a high-risk population (Knowler et al., 2009; NIDDK, 2011). They found that there was a 58%
reduction in the occurrence of type 2 diabetes with lifestyle changes alone, with weight loss being a significant predictor, compared to 31\% with medication over a 3 year period (Hamman et al., 2006; NIDDK, 2011). Likewise, Look AHEAD examined the long-term effects (11.5 year follow-up) of intensive lifestyle treatment in persons with type 2 diabetes. Findings showed that clinically significant weight loss resulted in greater improvements in cardiovascular disease risk factors and glucose control compared to individuals receiving usual diabetes care (Hill & Kris-Etherton, 2008; Pi-Sunyer et al., 2007; Wing, 2010). Together, these studies have been integral in establishing the significant long-term health benefits of moderate weight loss (5-10\% of body weight; Knowler et al., 2009; Perri & Corsica, 2002; NIDDK, 2011).

Treatment

For the past several decades research has examined effective strategies for the treatment of obesity (Wing, 2002). The three types that have emerged are: surgical, pharmacological and behavioral or lifestyle. While surgical and pharmacological treatments are efficacious, they are more intensive, expensive, and target a very specific population. Individuals must meet a certain BMI, among other health-related factors, and be unable to lose weight with lifestyle modifications alone (Wadden, Butryn, & Wilson, 2007). As such, behavioral interventions are the most widely used programs for weight loss and are considered the cornerstone of obesity treatment (Kalodner & Lucia, 1990; Shaw, O'Rourke, Del Mar, & Kenardy, 2005). The goals of behavioral treatment are to teach skills to modify eating behaviors, evaluate antecedents and consequences of eating, change maladaptive thoughts and manage relapses (Kalodner & Lucia, 1990; Shaw et al., 2005). These interventions include components on diet, exercise and behavior therapy (Panel, N.O.E.I.E., 1998). However, some researchers only focus on a specific component. For example, researchers have examined energy content and macronutrient
composition of food, as well as very low-caloric diets, low-carbohydrate diets and low-fat diets (Volek, VanHeest, & Forsythe, 2005). Other researchers have investigated exercise strategies, such as resistance training, lifestyle activities, and varying the intensity and duration of exercise (Volek et al., 2005).

While research has examined the efficacy of these components on weight reduction, typically the most successful interventions combine multiple components (Lang & Froelicher, 2006; Wing, 2002). For example, a study that combined diet and exercise found participants had greater initial weight loss (8.9 kg) after one year compared to diet or exercise alone (6.8 kg and 2.9 kg; Skender et al., 1996). In addition, over two years, the combined treatment had better maintenance (2.2 kg maintained) than the diet-only group, who regained 0.9 kg above baseline (Skender et al., 1996; Wing, 2002). Another study reported similar findings, with a diet and exercise group maintaining 72% of their 6 month weight loss compared to 60% maintained by a diet-only group (Wing, Venditti, Jakicic, Polley, & Lang, 1998; Wing, 2002).

Behavioral treatment programs define success as a 5-10% weight loss that is maintained for one year (Panel, N.O.E.I.E., 1998; Perri & Corsica, 2002; Wing & Hill, 2001). While behavioral programs are successful in the short-term – typically the maximum weight loss is achieved at 6 months during treatment – long-term attempts (weight maintenance) continue to pose a challenge (Jeffery et al., 2000). Most participants regain about a third of their initial weight loss after one year (Gaesser, 2009), and, by five years, more than 50% regain most of their weight (Perri & Corsica, 2002; Wadden, Sternberg, Letizia, Stunkard, & Foster, 1989). However, while some participants regain weight following treatment, others are able to maintain their weight loss. This variability has led researchers to examine predictors of weight loss. Identifying characteristics of individuals that have been successful at weight loss, and
components of treatment associated with better treatment outcomes, not only optimizes the
efficacy of treatment, but allows for better matching between treatment and the individual.

Weight Loss

Many different approaches have been examined to improve long-term weight loss. These include increasing contact and length of treatment, providing prepackaged, portion-controlled food, monetary incentives, greater emphasis on exercise, peer support, and teaching maintenance-specific skills, such as relapse prevention (Jeffery et al., 2000; Perri & Corsica, 2002; Wadden et al., 2007). In one study, individuals who attended 26 biweekly maintenance sessions the year following treatment maintained 82.7% of their weight loss, whereas those who did not (i.e., in the behavior therapy condition with no maintenance sessions) maintained only 33.3% (Perri et al., 1988). Another study evaluated the effects of recruiting participants alone or with friends or family members, and found after 6 months following behavioral treatment that 24% of participants recruited alone maintained their weight loss compared to 66% of participants recruited with friends or family (Wing & Jeffery, 1999). However, while many of the strategies designed to mitigate weight regained over time are successful during maintenance sessions, these programs are costly and not feasible as a long-term solution, as most individuals still regain their lost weight after treatment ends.

In addition, researchers have examined individual difference characteristics of successful weight losers (i.e., those that have maintained their weight loss following treatment). For example, self-motivation, autonomy, and having fewer previous dieting and weight loss attempts predict better weight loss outcomes (Teixeira, Going, Sardinha, & Lohman, 2005). In addition, having greater body dissatisfaction, unrealistic weight loss goals and low self-efficacy predict worse weight loss outcomes (Teixeira et al., 2005). Elfhag (2005) concluded that the successful
maintainer is one who loses weight early in treatment, leads an active lifestyle, has a regular meal routine that includes eating breakfast, has control over their food intake, monitors weight-related behaviors, has good coping strategies and is able to manage relapses (Elfhag & Rössner, 2005).

Another rich source of data on the predictors of successful long-term weight loss has come from the National Weight Control Registry (NWCR). The NWCR contains over 3,000 individuals who, in order to be eligible, must have maintained at least a 30-lb weight loss for at least one year (Wing & Hill, 2001). Subjects in the NWCR are on average 45 years old, mostly female (80%), Caucasian (97%) and married (67%; Wing & Hill, 2001). The average reported weight loss is 30 kg and the average length of maintenance is 5.5 years (Wing & Hill, 2001). The vast majority of subjects (89%) modified food intake and exercise to sustain their weight loss (Wing & Hill, 2001). Three of the most common strategies used were: consuming a low-fat and high carbohydrate diet, self-monitoring food intake and body weight, and engaging in physical activity (Wing & Hill, 2001). Among those who modified food intake, 88% restricted intake of certain types of foods and 44% limited their consumption. In addition, successful maintainers avoided fried foods, substituted foods low in fat, and engaged in an hour of regular physical activity each day (Wing & Hill, 2001).

Similarly, another study that recruited women from a large health maintenance organization examined characteristics of individuals who regained weight after successful weight loss (relapsers), along with those who maintained their weight loss (maintainers; Kayman, Bruvold, & Stern, 1990). Researchers found that maintainers incorporated strategies specific to their lifestyle. These included changes to cooking methods, such as not frying food, engaging in regular exercise, consuming reduced fat and reduced sugar foods, more fruits and vegetables, and
eating less (Kayman et al., 1990). Relapsers, on the other hand, engaged in less exercise, consumed more snacks a day (4.6 vs. 1.5), more candy and chocolate (41% vs. 17%), and had worse coping strategies (e.g., using food to make themselves feel better; Kayman et al., 1990).

Self-Monitoring

Regular self-monitoring of diet and exercise and self-weighing have appeared as key contributors to successful weight loss in several studies. In the NWCR, 75% of subjects weigh themselves more than once per week and 50% count calories (Klem, Wing, McGuire, Seagle, & Hill, 1997). Furthermore, subjects who monitored more frequently maintained an 18 kg weight loss after 1 year, while those who monitored less frequently only maintained 5 kg (Wing & Hill, 2001). Another study that compared successful weight losers and maintainers with those unsuccessful at weight loss found that individuals who are successful plan meals more days of the week (35.9% successful vs. 24.9% unsuccessful), track calories (17.7% vs. 8.8%), track fat (16.4% vs. 6.6%), measure portions (15.9% vs. 6.7%), and weigh themselves daily (20.3% vs. 11.0%; Kruger, Blanck, & Gillespie, 2006).

Self-monitoring allows individuals to create a caloric deficit during the weight loss phase and to recognize signs of weight regain, and use appropriate strategies to counteract the trend during the weight maintenance phase. Monitoring dietary intake is positively correlated with weight change (Baker & Kirschenbaum, 1993), and regular self-weighing is associated with lower BMI and greater weight loss (Carels et al., 2005; Carels et al., 2008; Linde, Jeffery, French, Pronk, & Boyle, 2005; VanWormer et al., 2009). For example, participants who weigh themselves weekly are six times more likely to lose at least 5% of their initial weight (VanWormer et al., 2009). Similarly, individuals enrolled in a behavioral weight loss program
(BWLP) who lost 5% of their body weight self-monitored more than twice as many days compared to those who did not (Carels et al., 2005).

Similarly, individuals who regularly weigh themselves also engage in other healthy lifestyle behaviors, such as engaging in more exercise and consuming less fat (Carels et al., 2005). Despite these benefits, the frequency of self-monitoring behaviors commonly attenuates over time. For example, a study that examined predictors of weight regain one year following treatment found that those who gained weight decreased the frequency of self-monitoring compared to those that maintained their weight loss (McGuire, Wing, Klem, Lang, & Hill, 1999). Furthermore, participants who decrease the frequency of self-weighing consume more calories from fat, and evidence increased dietary disinhibition and decreased cognitive restraint (Butryn, Phelan, Hill, & Wing, 2007). Therefore, efforts towards minimizing the decline in these behaviors and increasing adherence to self-monitoring may be important in achieving long-term weight loss.

**Personality**

Researchers have long hypothesized that an individual’s ability to engage in regular self-monitoring and self-weighing, as well as successfully regulate caloric intake, exercise, and lose weight is influenced by personality. One of the most widely examined and comprehensive taxonomy of personality traits is the Five-Factor Model (FFM; Costa & McCrae, 1990). The FFM (“Big Five”) is a trait theory that describes personality as stable and enduring patterns of behavior. According to this model, personality is hierarchical, such that lower order facets (specific traits) define higher order factors. These higher order factors are broad themes, or domains, that describe individual differences. The five domains in the FFM are: Neuroticism (emotional stability), Openness to Experience (intellect, creativity), Agreeableness (altruism),
Conscientiousness (order, self-discipline) and Extraversion (sociability). Researchers arrived at these domains using factor analysis to identify clusters of data from peer and self-report ratings, as well as adjective-rating scales and questionnaires (McCrae & Costa, 1987).

The FFM has been validated with other cultures and populations (Rolland, McCrae, & Allik, 2002) and used to analyze a wide variety of issues, ranging from job satisfaction (Judge, Heller, & Mount, 2002) to coping style (Watson & Hubbard, 1996). It has been established that personality characteristics are associated with attitudes, behaviors (Ajzen, 2005), and health (Adler & Matthews, 1994). The idea is that individuals engage in behaviors that are congruent with their personality. These behaviors can be healthy or harmful, depending on whether someone scores high or low on a particular trait. Someone who is very conscientious, for example, may pay close attention to their health and engage in behaviors that promote it, such as going for annual check-ups, checking food labels, flossing regularly, etc. On the other hand, someone low on conscientiousness may have no regard for or lack control of their behaviors and engage in unhealthy practices, such as smoking, alcohol or drug use, unhealthy eating habits, etc.

While several domains in the FFM are found to be predictors of health behaviors, conscientiousness shows the most consistent evidence. Conscientiousness is defined as being goal-oriented, meticulous, organized, thorough, persistent, and motivated (Costa, McCrae, & Dye, 1991; Piedmont, 1998). Conscientious individuals appear less likely to act on impulses and think before they act. The construct is composed of six traits: competence, order, dutifulness, achievement striving, self-discipline and deliberation (Costa et al., 1991). Evidence of a relationship between conscientiousness and health behaviors has been observed in both cross-sectional and longitudinal studies, as well as across diverse samples and a wide range of areas associated with health.
Beyond the FFM, another personality trait that has shown some evidence for an association with health-related behaviors is impulsivity. Impulsiveness is hypothesized to be a multifaceted construct that is composed of several distinct personality traits (Stanford et al., 2009). Barratt, one of the prominent researchers who explored this trait, noted that it is similar to other “action-oriented” traits, like risk taking and sensation-seeking (Stanford et al., 2009). He proposed that impulsivity consisted of three subtraits: motor impulsiveness (acting without thinking), attentional impulsiveness (inability to focus) and non-planning (lack of control; Barratt, 1985; Stanford et al., 2009). While other researchers have different perspectives on what subtraits comprise impulsivity (e.g., Eysenck, Newman, Dickman; Whiteside & Lynam, 2001), Barrett’s measure of impulsivity is the oldest and most widely used (Stanford et al., 2009). There is strong interest in the role of impulsivity because of its association with risky, often problematic, behaviors, as well as its link to overeating and weight gain. Moreover, in relation to other personality traits, impulsivity has a strong inverse relationship with conscientiousness (e.g., r’s range from -.53 to -.70; Hair & Hampson, 2006; McCrae & Costa, 2010; Zilberman, Tavares, & El-Guebaly, 2003).

**Personality and Health Behaviors**

Regarding personality and health behaviors, conscientiousness is one of the strongest predictors of health behaviors (Booth-Kewley & Vickers, 1994). In fact, research shows conscientiousness is a significant predictor of overall longevity (Friedman et al., 1993; Martin, Friedman, & Schwartz, 2007). Friedman and colleagues (1993) studied various dimensions of personality and found high scores on conscientiousness in childhood predicted greater longevity later in adulthood (Friedman et al., 1993). Among adults, conscientiousness is associated with fewer physical illnesses and disorders (Goodwin & Friedman, 2006). Also, individuals high on
Conscientiousness engage in more preventive behaviors (Bogg & Roberts, 2004; Booth-Kewley & Vickers, 1994; Courneya & Hellsten, 1998; Roberts, Walton, & Bogg, 2005) and have positive attitudes towards health (Lemos-Giráldez & Fidalgo-Aliste, 1997).

Conversely, individuals low on conscientiousness engage in more risky behaviors (e.g., smoking, alcohol and drug use; Hampson, Goldberg, Vogt, & Dubanoski, 2006; Lemos-Giráldez & Fidalgo-Aliste, 1997; Vollrath & Torgersen, 2002). Lemos-Giráldez and Fidalgo-Aliste (1997) examined the Big Five personality characteristics and health behaviors and attitudes in college students, and found that low conscientiousness predicted engagement in unhealthy habits (e.g., alcohol consumption, unhealthy dietary practices and smoking behavior) in men and women. It is hypothesized that the effect that personality traits have on behaviors emerges early in life and persists through adulthood. For example, a longitudinal study that examined the influence of personality characteristics on health found conscientiousness in childhood predicted later health behaviors in both men and women. Specifically, low conscientiousness resulted in poor self-rated health and increased smoking (Hampson et al., 2006). While conscientiousness plays a prominent role in health habits, there is also modest support for impulsivity. For example, Lemos-Giráldez and Fidalgo-Aliste (1997) observed that high impulsivity predicted unhealthy habits only in men (Lemos-Giráldez & Fidalgo-Aliste, 1997).

**Personality and Eating Behaviors**

In terms of behaviors related to successful weight loss, conscientiousness is associated with healthy dietary practices. Conscientious individuals are more likely to avoid fats, substitute low-fat for high-fat foods, and consume more fruits and vegetables (Goldberg & Strycker, 2002; O’Connor, Conner, Jones, McMillan, & Ferguson, 2009; Raynor & Levine, 2009). Conscientious individuals also have more awareness and control (restraint) regulating food
intake (Elfhag & Morey, 2008; Konttinen, Haukkala, Sarlio-Lähteenkorva, Silventoinen, & Jousilahti, 2009). Showing greater restraint not only relates to lower emotional and uncontrolled eating, but better control over weight. Konttinen and colleagues (2009) found that obese men and women who scored higher on restraint had a lower BMI/waist circumference, suggesting they were more successful at controlling their weight than obese individuals lower on restraint (Konttinen et al., 2009). Further, another study found severely obese individuals with high restraint lost more weight after one year of behavioral weight loss treatment (Bjorvell, Aly, Langius, & Nordstrom, 1994). Therefore, it is plausible that conscientious favorably influences weight loss outcomes by facilitating dietary restraint.

Additionally, previous research shows impulsivity is associated with overeating. Individuals who score higher in impulsivity are more susceptible to impulses and have greater difficulty regulating food intake (Elfhag & Morey, 2008; Guerrieri, Nederkoorn, & Jansen, 2007a; Guerrieri et al., 2007b; Nasser, Gluck, & Geliebter, 2004; Yeomans, Leitch, & Mobini, 2008). One study found impulsive individuals are more likely to eat in response to external food cues, such as sight and smell, and to be emotional eaters (Elfhag & Morey, 2008). In addition, they are more likely to eat when they are not physically hungry and experience more loss of control during a binge (Nasser, Gluck, & Geliebter, 2004). Also, Guerrieri and colleagues (2007a) examined eating behavior in normal weight female students and found that impulsivity predicted food intake. Specifically, highly impulsive women consumed more chocolate candies (an additional 27 kcal) than those who scored lower (Guerrieri et al., 2007a; Guerrieri et al., 2007b).

*Personality and Exercise*
In addition to healthy eating, conscientiousness is associated with exercise. Individuals who are more conscientious report engaging in more physical activity (i.e., they exercise more frequently and engage in higher levels of exercise; Courneya & Hellsten, 1998; Courneya, Bobick, & Schinke, 1999; Hoyt, Rhodes, Hausenblas, & Giacobbi, 2009; Marks & Lutgendorf, 1999; O’Connor et al., 2009; Raynor & Levine, 2009; Rhodes & Smith, 2006). One study found that students who were high on conscientiousness were more likely to engage in moderate to vigorous exercise, as well as do strengthening exercise (Raynor & Levine, 2009). The relationship between conscientiousness and exercise is also observed in older adults (those who are older than 65; Marks & Lutgendorf, 1999). Highly conscientious individuals also have better adherence, less difficulty maintaining a regular routine and perceive fewer barriers to exercising (e.g., lack of energy or motivation; Courneya & Hellsten, 1998; Courneya et al., 1999).

**Personality and Weight**

One of the consequences of personality’s influence on behavior and lifestyle habits is its effect on body weight. A review of the literature shows consistent evidence of a relationship between conscientiousness and impulsivity with BMI. Namely, conscientiousness is negatively related to BMI and impulsivity is positively related to BMI (Brummett et al., 2006; Chapman, Fiscella, Duberstein, Coletta, & Kawachi, 2009; Sutin, Ferrucci, Zonderman, & Terracciano, 2011; Terracciano et al., 2009). Terracciano and colleagues (2009) examined personality characteristics of underweight, normal weight and overweight individuals, and found that not only was low conscientiousness and high impulsiveness related to overweight and obesity, but, after accounting for demographic variables, impulsivity was the strongest predictor of BMI (Terracciano et al., 2009). Specifically, those in the top 10% of impulsiveness were 4 kg heavier than those in the bottom 10% (Terracciano et al., 2009). Another study that collected data over
50 years, using a diverse sample of men and women, found a similar finding. That is, there is a positive relationship between impulsivity and obesity, with individuals in the top 10% weighing 11 kg heavier than those in the bottom 10% (Sutin et al., 2011). Another study found a small effect between conscientiousness and BMI during midlife. In this study, adults in the upper quartile had a 0.9 kg lower BMI than those in the lower quartile (Brummett et al., 2006). In addition, conscientious individuals tend to have a smaller increase in BMI with age (Brummett et al., 2006), and are able to maintain a more steady weight compared to impulsive individuals who experience weight fluctuations (Sutin et al., 2011). In terms of gender, while studies report no differences between men and women, the association is stronger amongst women (Brummett et al., 2006; Chapman et al., 2009).

**Personality and Treatment**

When it comes to treatment, personality characteristics can influence willingness to adhere to prescribed regimes. High conscientiousness is related to better treatment adherence in patients on renal dialysis (Brickman, Yount, Blaney, Rothberg, & De-Nour, 1996; Christensen & Smith, 1995), patients with HIV (O'Cleirigh, Ironson, Weiss, & Costa, 2007) and adults with high cholesterol (Stilley, Sereika, Muldoon, Ryan, & Dunbar-Jacob, 2004). This can have a significant effect on health outcome. In one study, patients that were more conscientious adhered to treatment and thus had longer renal deterioration time (i.e., the time to renal failure; Brickman et al., 1996). In addition to better treatment adherence, conscientious individuals are more likely to obey doctor’s orders, take their medication and attend appointments (Hill & Roberts, 2011; Mutén, 1991; O'Cleirigh et al., 2007; Siegler, Feaganes, & Rimer, 1995). Conversely, impulsivity has a negative relationship with adherence. Impulsive individuals are less likely to adhere to treatment and, as a result, have higher attrition (Hjördis & Gunnar, 1989).
This was also found in adolescents with Type 1 diabetes who were less likely to follow diets prescribed to them by their doctor (Wheeler, Wagaman, & McCord, 2012).

Conscientiousness also plays a role in the maintenance of behavior. Rhodes and colleagues (2001) examined exercise motivation and behavior in breast cancer survivors and found maintainers (i.e., active during treatment and after treatment) had higher scores on conscientiousness than those who were inactive (i.e., not active during and after treatment; Rhodes, Courneya, & Bobick, 2001). However, the opposite is found with impulsivity. In one study, more impulsive individuals relapsed more quickly following a smoking cessation workshop than those who were less impulsive (Doran, Spring, McChargue, Pergadia, & Richmond, 2004).

In the area of weight loss, findings have been less consistent. For example, some studies report personality does not predict weight loss (Carlos Poston et al., 1999; Larsen et al., 2004). For example, Larsen and colleagues (2004) examined patients undergoing gastric bypass surgery and found that neuroticism, which is a domain of impulsivity, did not predict weight loss (short- and long-term; Carlos Poston et al., 1999; Larsen et al., 2004). Additionally, Carlos Poston and colleagues (1999) found that impulsivity did not predict initial weight loss in obese individuals enrolled in a treatment program (Carlos Poston et al., 1999; Larsen et al., 2004). However, other studies report different findings. One study found that impulsivity was negatively related with percentage of weight loss. In this study, severely obese adults who were enrolled in a combined behavioral treatment program that included exercise and nutrition advice, lost less weight at the end of 6 weeks (Hjördis, Gunnar, & Daisy, 1989). In children, impulsivity is actually shown to be associated with less weight loss after participation in a weight loss program (Nederkoorn, Jansen, Mulkens, & Jansen, 2007).
Less research has examined the relationship between weight loss and conscientiousness. Of the studies that have been done, divergent findings have been observed. One study explored personality traits and treatment with patients enrolled in an outpatient behavioral medicine program. In this study, individuals low on conscientiousness had worse treatment outcome and preferred not to be held accountable for their behavior choices (Mutén, 1991). Munro and colleagues (2011), on the other hand, found that conscientiousness was negatively correlated with weight loss in the group prescribed a very low energy diet (Munro, Bore, Munro, & Garg, 2011). The lack of consistent findings suggests further research on personality and successful weight loss is greatly needed.

Present Study

Personality traits are theorized to influence a person’s attitudes and behaviors, which, in turn, affect his or her health. Two personality traits consistently related to health and/or eating behaviors are conscientiousness and impulsivity. Conscientiousness (adherence to principles, achievement striving) and impulsivity (inability to control impulses) are inversely related to one another (e.g., r’s range from -.53 to -.70; Hair & Hampson, 2006; McCrae, R.R. & Costa, P.T., 2010; Zilberman, Tavares, & El-Guebaly, 2003). Individuals high on conscientiousness have fewer physical illnesses, engage in less risky behaviors (e.g., alcohol, drugs and smoking), regularly exercise, and have better treatment adherence. Impulsiveness, on the other hand, is linked to overeating and weight gain. Highly impulsive individuals have difficulty regulating food intake, eat in response to external food cues and are prone to binges. In terms of its relationship to body weight, conscientiousness is negatively related to BMI and impulsivity is positively related to BMI. However, weaker support is found for weight loss.
The goal of the present investigation was to explore how the personality traits of conscientiousness and impulsivity contributed to self-monitoring and weight loss behaviors in a sample of overweight and obese treatment-seeking adults. This study also explored whether personality traits led to better adherence and weight loss outcomes. To date, much of the research on personality traits have used a normal weight and/or undergraduate sample. Additionally, there is a gap in the extant literature that explores the relationship between personality and self-monitoring behaviors and adherence in this population. To be able to delineate predictors of health behaviors and treatment outcome in obese adults could lead to better matching between treatment and the individual. This, in turn, could hopefully reduce some of the variability observed in weight loss treatment program outcomes.

**Hypotheses of Study**

*H1*: Prior research shows clear evidence of a relationship between conscientiousness and impulsivity with BMI (Brummett et al., 2006; Chapman et al., 2009; Sutin et al., 2011; Terracciano et al., 2009). For example, one study found that individuals high on order (a facet of conscientiousness) weighed 4.5 kg less than those low on this trait (Sutin et al., 2011). Likewise, another study reported impulsivity to be a strong predictor of BMI (Brummett et al., 2006; Chapman et al., 2009; Sutin et al., 2011; Terracciano et al., 2009). Specifically, those in the top 10% of impulsiveness were 4 kg heavier than those in the bottom 10% (Terracciano et al., 2009). Therefore, it was expected that there would be a positive relationship between impulsivity and baseline BMI, and a negative relationship between conscientiousness and baseline BMI.

*H2*: Highly impulsive individuals have difficulty controlling impulses, regulating food intake, eat in response to external food cues, and experience more loss of control during a binge (Elfhag & Morey, 2008; Guerrieri et al., 2007a; Guerrieri et al., 2007b; Nasser et al., 2004; Yeomans et
One study examined food intake among normal weight female students and found that high impulsiveness predicted increased consumption (Guerrieri et al., 2007a; Guerrieri et al., 2007b). It was hypothesized then that individuals who scored high on impulsivity would have greater difficulty establishing eating-related habits, be less likely to watch their portions, and engage in unhealthy eating behaviors (i.e., consume more sweets, fast food, fewer fruits and vegetables, and high-fat and/or high-calorie food). In addition, because impulsivity is linked to overeating and higher BMI, it was hypothesized that impulsive individuals would consume more daily calories.

**H3:** Impulsivity plays a role in the maintenance of behavior. For example, in one study, impulsive individuals relapsed more quickly following a smoking cessation workshop than those who were less impulsive (Doran et al., 2004). In addition to their difficulty regulating food intake, it was hypothesized that impulsive individuals would be more likely to experience a dietary lapse in food intake. It was also hypothesized that highly impulsive individuals would have more difficulty overcoming this setback.

**H4:** Research shows conscientiousness is one of the strongest predictors of health behaviors (Booth-Kewley & Vickers, 1994). Individuals who are conscientious engage in healthy dietary practices that include avoiding fats, substituting low-fat for high-fat foods, consuming more fruits and vegetables (Goldberg & Strycker, 2002; O’Connor et al., 2009; Raynor & Levine, 2009), and report more physical activity (Courneya & Hellsten, 1998; Courneya et al., 1999; Hoyt et al., 2009; Marks & Lutgendorf, 1999; O’Connor et al., 2009; Raynor & Levine, 2009; Rhodes & Smith, 2006). In one study, students that were high on conscientiousness were more likely to engage in moderate to vigorous exercise (Raynor & Levine, 2009). Thus, it was hypothesized that conscientious individuals would report healthy dietary behaviors (i.e.,
consume low-fat foods and fruits and vegetables), have less difficulty establishing exercise-related habits, engage in more exercise (including setting aside more time for exercise and incorporating it into their daily routine), and burn more calories in activity.

H5: Conscientious individuals have better treatment adherence. This was reported among patients on renal dialysis (Brickman et al., 1996; Christensen & Smith, 1995), patients with HIV (O'Cleirigh et al., 2007) and adults with high cholesterol (Stilley et al., 2004). In addition to following prescribed treatments, individuals who high on conscientious are more likely to obey doctor’s orders, take their medication and attend appointments (Hill & Roberts, 2011; Mutén, 1991; O'Cleirigh et al., 2007; Siegler et al., 1995). Therefore, it was hypothesized that conscientious individuals would be more likely to follow treatment advice (e.g., track calories, plan meals ahead of time, measure portions, and shop for groceries from a list) and have better treatment adherence. Because conscientious individuals are more likely to adhere to treatment and engage in physical activity, it was also hypothesized that they would follow a structured exercise routine, make up for missing a day of exercise, and experience less difficulty adhering to exercise goals.

Conversely, individuals high on impulsivity have worse treatment adherence. One study found that highly impulsive adolescents with Type 1 diabetes were less likely to follow prescribed diets (Wheeler et al., 2012). Because impulsive individuals are susceptible to impulses, it was hypothesized that they would have more difficulty adhering to eating goals and worse dietary adherence.

H6: Highly conscientious individuals have more awareness and control (restraint) over their food intake (Elfhag & Morey, 2008; Konttinen et al., 2009). Previous research shows having higher restraint is associated with lower emotional and uncontrolled eating, better control over weight
and greater weight loss (Bjorvell et al., 1994; Konttinen et al., 2009). One study found that obese individuals with higher restraint lost more weight the year following treatment (Bjorvell et al., 1994). Because conscientious individuals are more likely to adhere to treatment, have healthy habits and better restraint, it was hypothesized that highly conscientious individuals would lose more weight following treatment. Conversely, there is a negative relationship between impulsivity and weight loss. This was observed in adults and children enrolled in a weight loss program (Hjördis et al., 1989; Nederkoorn et al., 2007). Therefore, it was hypothesized that highly impulsive individuals would lose less weight following treatment.
METHODS

Participants

Fifty-two overweight and obese adults participated in an eighteen week behavioral weight loss program (BWLP). 1 Participants were recruited from the community through advertisements in local newspapers, flyers posted in businesses and community centers, and campus email at a large Midwestern university. Participants were eligible if they were overweight or obese (BMI ≥ 27 kg/m²), provided informed consent and received their physician’s medical clearance. Participants were ineligible if they: (a) were currently pregnant or nursing; (b) had serious cardiovascular issues (e.g., recent heart surgery, pacemaker or heart attack in the last 6 months); (c) reported musculoskeletal problems that prohibited their ability to engage in exercise; (d) had Type 1 diabetes; (e) had uncontrolled hypertension; (f) had a psychiatric or terminal illness (e.g., Bipolar Disorder or cancer); (g) had a lap band from bariatric surgery; (h) were currently participating in another weight loss program; or (i) were planning to relocate within the study time frame.

All participants were required to submit a $100 deposit to encourage attendance at weekly meetings and reduce attrition at follow-up assessment. The deposit was conditional on the completion of the weight loss program. In cases of financial hardship, the deposit was prorated to $50 or, in special circumstances, waived. All procedures were approved by the University institutional review board.

Study Design

Participants were randomly assigned into one of two treatment groups; BWLP or BWLP with stepped care (SC). Treatment was based on combining elements from two previously

1 Of the 52 participants that participated in the program, only 42 (81%) completed the 18-week weight loss program.
validated weight loss programs: Transforming Your Life (TYL), which emphasized disrupting unhealthy habits and developing healthy ones, modifying the environment by increasing healthy eating- and exercise-related cues, and facilitating motivation (Carels et al., 2011), and New Perspectives (NP) that focused on disrupting unhealthy relationships to food, body image acceptance and challenging internalized weight bias and stereotypes about weight (Carels et al., in press). Participants in the SC group received the same treatment as BWLP, but were eligible to be “stepped-down” if they met pre-established weight loss goals.

In this study, participants that were stepped-down transitioned from attending weekly group meetings to continuing with the program on their own (i.e., they were told to continue reading a chapter from the manual each week and to self-monitor, but did not attend weekly group meetings). Participants were eligible to be stepped-down during weeks 6 or 12 if they lost at least 3% of their body weight over the previous six week period. In addition, participants who were stepped-down at week 6 but did not lose at least 3% by week 12 were stepped-up (i.e., placed back into their original group). The SC eligibility criteria were designed to provide a cost-effective approach to treatment. The logic behind it is some individuals may only need minimal guidance and thus avoids the cost of unnecessary treatment.

The entire length of treatment was eighteen weeks and each group met in small groups, consisting of 10-15 people, weekly for 90 minutes. Groups were led by a licensed clinical health psychologist and/or graduate students specializing in health psychology. Participants were instructed to read a chapter from a weight loss manual each week, self-monitor calories and exercise, and create a 500 calorie/day deficit through diet and physical activity. Assessments were conducted prior to treatment (baseline), at the stepped-down periods (i.e., weeks 6 and 12),
and at week 18 (post-treatment). During these assessments, participants completed questionnaires and had their height, weight and body fat measured.

**Measures**

*Demographic Information.* Basic demographic information, such as age, gender, race, income and education, was collected.

*Height and Body Weight.* Weight was measured to the nearest 0.1 pound using a digital scale (BF-350e, Tanita, Arlington Heights, IL). The initial group meeting (orientation) was considered the baseline weight. Height was measured to the closest 0.5 inch using a height rod on a standard spring scale. Height and weight were converted into kilograms and meters to calculate BMI. The percent change in body weight was calculated by taking baseline and post-treatment weight (i.e., subtracting post-treatment weight from baseline weight and dividing it by baseline weight).

*Dietary Intake.* Participants were instructed how to self-monitor dietary intake and were provided demonstrations of common food measurement procedures, as well as instructions for estimating food portion sizes. Participants used a food and beverage calorie guide provided by Internet dietary analysis programs, such as Calorie King (http://www.calorieking.com) or Nutrition Data (http://www.nutritiondata.com), to estimate energy intake from meals, snacks and beverages. Participants were further instructed on how to electronically submit (or submit by paper and pencil) daily records of caloric intake from breakfast, lunch, dinner, snacks, non-alcoholic beverages, alcoholic beverages, and total caloric intake (i.e., total energy intake). Meals and snacks were defined by the participants based on their common practices. In the present study, only total caloric intake was used.
**Physical Activity and Energy Expenditure.** Caltrac accelerometers were provided to participants to assess total energy expenditure. The Caltrac accelerometer measures vertical acceleration and converts the measurement into an energy expenditure value. Energy expenditure (accelerometer readings for total calories expended during consecutive 24 hour periods) and daily self-reported physical activity (duration of physical activity, not including activity associated with daily living, such as occupational exertion or taking the stairs) were submitted by participants. No objective assessments of physical exertion (i.e., sweating, heart rate) were performed, and participants were instructed to record all purposeful physical activity, regardless of intensity.

**Adherence.** Three types of adherence were measured: treatment, dietary and exercise. Treatment adherence was assessed by the number of self-monitoring diaries submitted, while dietary adherence and exercise adherence were measured by examining the caloric deficit created between caloric intake and energy expenditure, and daily self-reported physical activity.

**Weight Loss and Self-Monitoring Behaviors Questionnaire (WLSBQ).** Participants answered 15 questions about their engagement in healthy weight loss behaviors over the past seven days. These included: planning/preparation behaviors (e.g., how often do you plan your meals and snacks ahead of time?), self-monitoring diet behaviors (e.g., how often do you track calories?), portion control strategies (e.g., how often do you measure the food on your plate?), healthy/unhealthy eating behaviors (e.g., how often do you eat low-fat and/or low-calorie foods?), and physical activity behaviors (e.g., how often do you incorporate exercise into your daily routine?). Items were rated on a 4- and 5-point Likert-type scale and assessed the frequency of performing behaviors associated with weight loss and maintenance. Questions were based on previous research (e.g., weight loss behaviors and strategies reported among
successful weight losers; Kayman et al., 1990; Kruger et al., 2006; Wing & Hill, 2001) and existing questionnaires (e.g., Eating Behavior Inventory and Diet and Physical Activity Self-Management Survey; Nothwehr, Dennis, & Wu, 2007; O'Neil et al., 1979). Participants completed this questionnaire at baseline and post-treatment. See Appendix A.

Weight Loss Goals Questionnaire (WLGQ). Participants answered seven questions on the difficulty of self-monitoring and adhering to weight loss goals, and the number of times they encountered a relapse. The items that assessed difficulty were rated on a 7-point Likert-type scale, ranging from 1 (not at all difficult) to 7 (very difficult). There were an equal number of questions that asked about eating and exercise (3 items each), with the seventh question pertaining to both eating and exercise. In addition, participants were told to base their answers on the past seven days. This questionnaire was constructed for the purposes of this investigation, and was completed during the stepped-down periods (weeks 6 and 12) and post-treatment. See Appendix B.

Impulsivity. The Barratt Impulsiveness Scale (BIS-11; Patton, Stanford, & Barratt, 1995) is a 30-item self-report questionnaire that measures trait impulsiveness. It is one of the most widely used measures and has been examined in both community and clinical populations (Patton et al., 1995; Stanford et al., 2009). The BIS-11 contains 3 subscales that assess different aspects of impulsiveness: attention (8 items; e.g., “I have racing thoughts”), motor (11 items; e.g., “I do things without thinking”) and nonplanning (11 items; e.g., “I plan trips well ahead of time”). Items are rated on a 4-point Likert-type scale, ranging from 1 (rarely/never) to 4 (almost always/always). While the subscales (or second-order factors) can be examined separately, only the total score was used in the present study. Total scores range from 30 to 120, with higher scores indicating greater impulsiveness. The measure has good internal consistency (Cronbach’s
alpha ranges from .79 to .83), test re-test reliability at one month, and construct validity (Patton et al., 1995; Stanford et al., 2009). Participants completed this questionnaire at baseline only. Cronbach’s alpha in the current study was .88. See Appendix C.

Conscientiousness. Conscientiousness was assessed using the NEO Personality Inventory-3 (NEO-PI-3; McCrae & John, 1992). The NEO-PI-3 is the latest version of the NEO-PI-R, which is based on Catell’s Five Factor Model of personality. The NEO Inventories are one of the most comprehensive and widely used measures of personality. While the NEO-PI-3 measures five domains of personality (neuroticism, extraversion, openness, agreeableness and conscientiousness), only conscientiousness was examined in the current investigation. The conscientious domain contains 48 items that are rated on a 5-point Likert-type scale that ranges from 1 (strongly disagree) to 5 (strongly agree). In addition, the subscale contains six facets: competence, order, dutifulness, achievement striving, self-discipline and deliberation. However, only the total score (conscientious domain) was used in the present study. The NEO-PI-3 has good internal consistency (Cronbach’s alpha for the domains range from .87 to .93) and demonstrated construct validity in adolescent and adult samples (McCrae, Costa, & Martin, 2005; McCrae & Costa, 2010). This questionnaire was completed at baseline. In the present study, Cronbach’s alpha was .92. See Appendix D.

Habit Index. The Self-Report Habit Index (SRHI; Verplanken & Orbell, 2003) is a 12-item measure of habitual action. Items assess the automaticity and frequency of behavioral habits. Participants rated their level of agreement about healthy eating and physical activity on a 7-point Likert-type scale that ranged from strongly disagree to strongly agree. A meta-analysis found that the SRHI shows moderate to strong correlations with dietary and activity behaviors (Gardner, de Bruijn, & Lally, 2011). In terms of its psychometric properties, it has high test re-
test reliability (Cronbach’s alpha = .91) and shows good construct validity (Verplanken & Orbell, 2003). Participants completed this measure at baseline and post-treatment. In this study, Cronbach’s alpha for healthy eating was .93 (baseline) and .92 (post-treatment), and for physical activity was .96 (baseline) and .97 (post-treatment). See Appendix E.

**Data Analysis**

ANOVA, t-tests, and bivariate correlations were used to examine the association between demographic variables (i.e., BMI, age, gender, race, income, and education) and personality traits. The association between conscientiousness and impulsivity was also examined using a bivariate correlation. To reduce the total number of variables being analyzed, composite variables were created for two of the questionnaires that examined weight loss behaviors and self-monitoring practices, and weight loss goals and relapses. For the Weight Loss and Self-Monitoring Behaviors Questionnaire (WLSBQ), all 15 items administered at pre- and post-treatment were transformed into z-scores then averaged. Cronbach’s alpha was .77 at baseline and .87 at post-treatment. For the Weight Loss Goals Questionnaire (WLGQ), data collected was averaged across weeks 6, 12 and 18 then transformed into z-scores and separated into two groups: eating goals and exercise goals. Cronbach’s alpha was .87 (eating goals) and .86 (exercise goals). Caloric intake and energy expenditure were averaged over the entire intervention for each participant. To explore relations between variables of interest (eating and exercise habits, weight loss behaviors, eating and exercise goals, adherence, caloric intake, and energy expenditure) and personality traits, bivariate correlations were run at baseline and multiple regressions analyses were conducted at post-treatment. Regression analyses examining post-treatment outcomes controlled for treatment group status and pre-treatment level of the outcome variable. Bivariate correlations were also performed between variables of interest.
Finally, post-hoc analyses were run to examine potential associations between the composite variables, WLSBQ and WLGQ, and weight loss. Missing data was handled using pairwise deletion to allow for maximum power to detect relationships between variables of interest.
RESULTS

Preliminary Analyses

Preliminary analyses of relationships between demographic variables (i.e., BMI, age, gender, race, income, and education) and personality traits indicated significant correlations between conscientiousness and income ($r = .276$, $p < .05$), and conscientiousness and education ($r = .330$, $p < .05$). No significant correlations were found for impulsivity and demographic variables. The variables income and education were controlled for in subsequent analyses.

Results also showed significant relationships between the WLSBQ and WLGQ. Specifically, individuals who engaged in healthy weight loss behaviors at baseline on the WLSBQ were more likely to engage in these behaviors at post-treatment ($r = .50$, $p < .01$), and individuals that practiced healthy weight loss behaviors at post-treatment on the WLSBQ reported fewer difficulties adhering to eating ($r = -.64$, $p < .001$) and exercise ($r = -.71$, $p < .001$) goals on the WLGQ during treatment.

Descriptive statistics revealed that scores on personality traits were normally distributed (Conscientious: $M = 123.1$, $SD = 22.2$; Impulsivity: $M = 62.7$, $SD = 12.1$) and consistent with prior research (e.g., mean conscientious scores range from 121.1 to 124.3, while impulsivity scores range from 61.8 to 67.7; Davis et al., 2008; McCrae, R.R. & Costa, P.T., 2010; Stilley, et al., 2004; Weller, Cook, Avsar, & Cox, 2008). In addition, Pearson correlation analysis revealed that conscientiousness and impulsivity were inversely related ($r = -.64$, $p < .001$).

Main Analyses

Hypothesis 1. Hypothesis 1, that there would be a negative relationship between conscientiousness and BMI and a positive relationship between impulsivity and BMI, was not
supported. Results using Pearson’s correlation coefficient and multiple regression analysis are included in Tables 1 and 2.

Hypothesis 2. Hypothesis 2, that impulsive individuals would have worse eating habits (i.e., SRHI), weight loss behaviors (i.e., WLSBQ), eating goals (i.e., WLGQ), dietary adherence, and caloric intake, was not supported. Results using Pearson’s correlation coefficient and multiple regression analysis are included in Tables 3 and 4.

Hypothesis 3. Hypothesis 3, that conscientious individuals would have better exercise habits (i.e., SRHI), weight loss behaviors (i.e., WLSBQ), exercise goals (i.e., WLGQ), exercise and treatment adherence, and energy expenditure, was not supported. Results using Pearson’s correlation coefficient and multiple regression analysis are included in Tables 5 and 6.

Hypothesis 4. Hypothesis 4, that there would be a positive relationship between conscientiousness and weight loss, and a negative relationship between impulsivity and weight loss, was not supported. Results using multiple regression analysis are included in Table 7.

Post-Hoc Analyses

Post-hoc analyses found significant relationships between weight loss and weight loss behaviors (i.e., WLSBQ) at post-treatment ($r = -.49, p < .01$), and weight loss and eating ($r = .68, p < .001$) and exercise ($r = .49, p < .01$) goals (i.e., WLGQ).
DISCUSSION

Personality traits have been shown to predict health behaviors and, in turn, affect health status (e.g., Elfhag & Morey, 2008; Friedman et al., 1993; Goodwin & Friedman, 2006; Guerrieri et al., 2007a; O’Connor et al., 2009; Raynor & Levine, 2009; Yeomans et al., 2008). However, little research has investigated the relationship between personality traits and weight loss behaviors and treatment outcomes. The present study sought to examine whether conscientiousness and impulsivity (two personality traits associated with body weight; e.g., Brummett et al., 2006; Sutin et al., 2011; Terracciano et al., 2009) influence weight loss behaviors (including self-monitoring practices), adherence, and weight loss in a sample of overweight and obese adults.

It was hypothesized that there would be a relationship between conscientiousness and impulsivity with BMI, weight loss behaviors (e.g., eating and exercise habits, weight loss goals, caloric intake, and energy expenditure), adherence, and weight loss. However, no significant relationships were found. The findings from this investigation are inconsistent with previous studies that have found associations between personality traits and health outcomes (e.g., Goldberg & Strycker, 2002; Guerrieri et al., 2007a; O' Cleirigh et al., 2007; Raynor & Levine, 2009; Sutin et al., 2011; Terracciano et al., 2009; Wheeler et al., 2012). A number of reasons may account for the null findings. First, it may be that the discrepancy between these results and the extant literature were due to the modest sample size in this investigation. The present study had a sample size of 52 at baseline and 42 at post-treatment. However, some of the effects in this investigation were quite small. For example, conscientiousness was correlated -0.11 with baseline BMI. Other studies reporting significant relationships between personality and health yielded similar effect sizes for BMI but with much larger samples (r’s ranged from -.06 to -.20;
e.g., Brummett et al., 2006; Hampson et al., 2006; Magee & Heaven, 2011; Sutin et al., 2011). Similar effect sizes were also observed for baseline exercise habits and treatment adherence, whose correlations with conscientiousness were 0.24 and 0.19, respectively. Again, these effect sizes were comparable to other studies with larger samples (exercise: $r$’s ranged from .14 to .23; e.g., Courneya, et al., 1999; Courneya & Hellsten, 1998; Raynor & Levine, 2009; adherence: $r$’s ranged from .17 to .33; Hill & Roberts, 2011; Stilley, et al., 2004). Finally, the effect sizes observed between conscientiousness and other health-related behaviors (e.g., seatbelt use, sleeping, smoking, and alcohol use) were comparable in magnitude to the present study (for smoking and alcohol, $r$’s ranged from -.11 to -.15, and for seatbelt use and smoking, $r$’s ranged from .13 to .22; Hampson et al., 2006; Raynor & Levine, 2009). This suggests that some of the null findings are likely to be secondary to insufficient power to detect the small effect.

Additional methodological differences may also account for the findings. Two of the questionnaires administered, Weight Loss and Self-Monitoring Behaviors Questionnaire (WLSBQ) and Weight Loss Goals Questionnaire (WLGQ), were developed for the present study. While both measures demonstrated good reliability (Cronbach’s alpha for WLSBQ was .77 at baseline and .87 at post-treatment, and, for the WLGQ, eating goals was .87 and exercise goals was .86) and good face validity, it is impossible to rule out issues related to poor construct validity or demand characteristics. For example, given that participants were treatment-seeking adults interested in a weight loss treatment program, they may have felt pressure to respond in a socially appropriate manner. In addition, while the items that compose both measures were based on previous research and existing scales, results from the present study were sometimes inconsistent with other studies that included similar items. For example, although non-significant, some items in the WLSBQ, such as fruit intake, showed a trend towards a negative
association with conscientiousness. However, other studies show consistent evidence that conscientiousness is associated with healthy dietary practices (e.g., avoidance of fats, fruit and vegetable intake, etc.; Goldberg & Strycker, 2002; Lemos-Giráldez & Fidalgo-Aliste, 1997; Raynor & Levine, 2009). While it is tempting to blame demand characteristics or poor construct validity, it is important to note that post-hoc analyses revealed significant relationships between weight loss and WLSBQ \( (r = -.49) \), and weight loss and WLGQ (eating goals: \( r = .68 \); exercise goals: \( r = .49 \)) in the expected direction. Thus, a more likely conclusion is that personality is not the best predictor of weight loss behaviors (as evidenced by the small effects), but that weight loss behaviors are significant predictors of weight loss.

Finally, there is the possibility that personality factors, such as trait impulsivity, have little or no impact on weight loss, caloric intake, or energy expenditure among participants in a weight loss program. For example, participants in a weight loss program receive considerable support and accountability, which may help to offset the detrimental influence of impulsivity on weight loss behaviors. In the present study, the findings are consistent with past research that has found mixed results (e.g., Brummett et al., 2006), no association (e.g., Galanti, Gluck, & Geliebter, 2007) or a significant positive relationship with BMI (e.g., Davis, Levitan, Smith, Tweed, & Curtis, 2006). It is important to note that impulsivity is often conceptualized and measured in a variety of different ways; again pointing to potential issues of construct validity and measurement error. For instance, some studies use the Five-Factor Model to measure impulsivity (e.g., Brummett et al., 2006; Chapman et al., 2009; Sutin et al., 2011; Terracciano et al., 2009), while others use Eysenck’s (e.g., Hjördis et al., 1989) or Barratt’s model (e.g., Davis, et al., 2006; Galanti, et al., 2007). However, even within these models, there are inconsistencies in the direction and magnitude of the reported association. For example, Davis and colleagues
(2006) reported a positive relationship between impulsivity and BMI \( r = .22; \) Davis, et al., 2006), while Galanti and colleagues (2007) found no association \( r = .03; \) Galanti et al., 2007). This suggests that the current investigation’s null findings may not be secondary to sample size entirely (because the above studies used the same instrument, yet reported different magnitudes), but instead may reflect issues of construct measurement or the existence of unmeasured moderators.

Overall, this study suggests that personality is likely a distal predictor of weight loss behaviors. In other words, they evidence weak effects and may only be present under certain specialized conditions. In contrast, weight-related behaviors (e.g., self-monitoring, exercise, etc.) were significantly associated with weight loss. These behaviors are occurring proximally and are likely to have a large impact when performed or not performed on subsequent weight loss. In other words, personality traits did not influence how often someone, for example, self-monitored, consumed fruits and vegetables, or attended group meetings and therefore had little impact on weight loss; however, the behaviors an individual engaged in did influence weight loss. The finding that behaviors predict weight loss is not novel. In fact, researchers that have investigated successful weight losers (i.e., those who lost 5-10%) have found, compared to relapsers (those who regained weight following treatment), that they engage in various eating and exercise-related strategies, such as avoiding fried foods, eating fruits and vegetables, and doing an hour of regular physical activity each day (Kayman et al., 1990; Wing & Hill, 2001). And, it is these strategies that are emphasized again and again in weight loss treatment programs.

Limitations

This study had several limitations. First, the sample was small and relatively homogeneous, as it was predominately Caucasian and female. In addition, there were a number
of restrictions placed on inclusion into the study (e.g., individuals could not have serious cardiovascular problems, Type 1 diabetes, mental health issues, musculoskeletal problems, etc.). This likely limits the generalizability of the findings to other, more diverse populations. Also, participants were overweight and obese treatment-seeking adults, which limit the generalizability to community samples. It may be that this self-selected sample was more motivated for treatment. Another limitation was the complexity of the weight loss intervention, notably in the stepped-care group. Participants in this treatment group transitioned from attending weekly group meetings to continuing with the program on their own if they achieved weight loss goals. Thus, it is difficult to separate external or internal factors that may have influenced outcomes. Finally, the study relied on self-report data to assess dietary and exercise behaviors. Self-report is known to be subject to bias. In fact, studies show that participants tend to underestimate caloric intake and overestimate energy expenditure (Lichtman et al., 1992; Schoeller, 1990).

Future Directions

A next step in weight loss research may be to identify characteristics that make a weight loss participant successful, with the rationale that by identifying who is likely to engage (or not engage) in certain behaviors, researchers can tailor treatment to the individual; thus, making it both effective and cost-effective. However, with regard to personality, the question remains whether the generally small effects observed with health behaviors are meaningful and worthy of future research in weight loss treatment. If personality traits predict mortality, then a small effect could have important public health implications (even if it indirectly reduces mortality by one percent). But, insofar that it predicts health behaviors in a weight loss sample, there are other factors that better account for the observed differences in treatment outcomes and are more
worthwhile to study. Also, given the complexities of personality, there would be a vast number of combinations of personality traits and potential moderators of outcomes.

Results from this study suggest that personality is not the best predictor of weight loss behaviors (instead, behaviors appear to have a much stronger influence on body weight). Future research might instead examine possible mediators of weight loss behaviors and weight loss outcomes, such as demographic variables, stress, or social support. Stress, for example, has been shown to influence unhealthy food choices and metabolic responses to foods (Kiecolt-Glaser, 2010). In the end, obesity is a multifaceted problem. Distal factors, such as personality, are modest predictors at best.

Obesity has emerged as a global epidemic with serious health and economic consequences. While behavioral interventions are the most widely used treatment, there is considerable variability in treatment outcomes. Researchers continue to try to identify individual difference characteristics that predict short- and long-term weight loss. However, much of the research to date is mixed. Research in this area is greatly needed, as it would not only optimize the efficacy of treatment, but would allow for better matching between treatment and the individual; thus making treatment both effective and cost-effective.
REFERENCES


Table 1

*Multiple Regression Analysis for Predicting Baseline Body Mass Index*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Predictor</th>
<th>B</th>
<th>SE B</th>
<th>( \beta )</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
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<td>.821</td>
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<td>.422</td>
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</table>

*Note. N = 54. BMI = Body Mass Index; Conscientiousness = NEO Personality Inventory-3 Conscientiousness Domain (higher scores indicate more conscientious).*
Table 2

*Correlation between Impulsivity and Baseline Body Mass Index*

<table>
<thead>
<tr>
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<th>BMI</th>
<th>Impulsivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
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</tr>
<tr>
<td>Impulsivity</td>
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<td>1.00</td>
</tr>
</tbody>
</table>

*Note. N = 55. BMI = Body Mass Index; Impulsivity = Barrett Impulsivity Scale (higher scores indicate more impulsive).*
Table 3

Correlations between Impulsivity and Baseline Eating Habits, and Weight Loss and Self-Monitoring Behaviors

<table>
<thead>
<tr>
<th></th>
<th>Impulsivity</th>
<th>Eating Habits</th>
<th>Weight Loss Behaviors</th>
</tr>
</thead>
<tbody>
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<td></td>
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<td>Eating Habits</td>
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<td>Weight Loss Behaviors</td>
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</tr>
</tbody>
</table>

Note. \(N = 55\). Impulsivity = Barrett Impulsivity Scale (higher scores indicate more impulsive); Eating Habits = Self-Report Habit Index – Eating (higher scores indicates healthy eating more frequent habit at baseline); Weight Loss Behaviors = Weight Loss and Self-Monitoring Behaviors Questionnaire (higher scores indicates more healthy weight loss behaviors at baseline).

** = \(p \leq .01\)
Table 4

Multiple Regression Analyses for Predicting Dietary Adherence, Caloric Intake, Eating Goals and Habits, and Weight Loss and Self-Monitoring Behaviors at Post-Treatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Predictor</th>
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<th>SE B</th>
<th>(\beta)</th>
<th>T</th>
<th>P</th>
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</thead>
<tbody>
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<td>Group</td>
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<td>.646</td>
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<td>Adherence</td>
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<td>Impulsivity</td>
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<td>.346</td>
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<td>Dietary Intake</td>
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<td>Group</td>
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<td>.679</td>
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<td></td>
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<td>.454</td>
<td>6.627</td>
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<td>.069</td>
<td>.946</td>
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<td>Eating Goals</td>
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<td>Group</td>
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<td>.662</td>
<td>.368</td>
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<td>.080</td>
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<td>.001</td>
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<tr>
<td>Behaviors_p</td>
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<td>Behaviors</td>
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<td>.007</td>
<td>.172</td>
<td>1.285</td>
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<tr>
<td></td>
<td></td>
<td>Impulsivity</td>
<td>.008</td>
<td>.007</td>
<td>.172</td>
<td>1.285</td>
<td>.207</td>
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</tbody>
</table>

*Note.* Dietary Adherence = Caloric deficit (higher scores indicate greater deficit created); Dietary Intake = Total caloric intake (higher scores indicate more calories consumed); Eating Goals = Weight Loss Goals Questionnaire – Eating (higher scores indicate greater difficulty adhering to eating goals and more lapses in eating healthy); Eating Habits_p = Self-Reported Habit Index – Eating (higher scores indicate higher frequency of eating habits).
scores indicates healthy eating more frequent habit at post-treatment); Weight Loss Behaviors_p = Weight Loss and Self-Monitoring Behaviors Questionnaire (higher scores indicates more healthy weight loss behaviors at post-treatment); Group = Treatment Group; Impulsivity = Barrett Impulsivity Scale (higher scores indicate more impulsive); Eating Habits = Self-Reported Habit Index – Eating (higher scores indicates healthy eating more frequent habit at baseline); Weight Loss Behaviors = Weight Loss and Self-Monitoring Behaviors Questionnaire (higher scores indicates more healthy weight loss behaviors at baseline)
Table 5

*Correlations between Conscientiousness and Baseline Exercise Habits, and Weight Loss and Self-Monitoring Behaviors*

<table>
<thead>
<tr>
<th></th>
<th>Conscientiousness</th>
<th>Exercise Habits</th>
<th>Weight Loss Behaviors</th>
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</thead>
<tbody>
<tr>
<td>Conscientiousness</td>
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<td>Weight Loss Behaviors</td>
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<td>.35**</td>
<td>1.00</td>
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</table>

*Note. N = 55. Conscientiousness = NEO Personality Inventory-3 Conscientiousness Domain (higher scores indicate more conscientious); Exercise Habits = Self-Reported Habit Index – Exercise (higher scores indicates physical activity more frequent habit at baseline); Weight Loss Behaviors = Weight Loss and Self-Monitoring Behaviors Questionnaire (higher scores indicates more healthy weight loss behaviors at baseline).  
** = p ≤ .01*
### Table 6

*Multiple Regression Analyses for Predicting Treatment and Exercise Adherence, Energy Expenditure, Exercise Goals and Habits, and Weight Loss and Self-Monitoring Behaviors at Post-Treatment*

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Predictor</th>
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<th>SE B</th>
<th>β</th>
<th>T</th>
<th>P</th>
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<tr>
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<tr>
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<td>Group</td>
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<td></td>
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<td>.011</td>
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*Note.* Treatment Adherence = Self-monitoring diaries (higher scores indicate more self-monitoring diaries submitted); Exercise Adherence = Daily self-reported physical activity (higher scores indicate more minutes spent doing exercise); Energy Expend = Total calories burned (higher scores indicate more calories burned during activity); Exercise Goals = Weight Loss Goals Questionnaire – Exercise (higher scores indicate greater difficulty adhering to exercise goals and more lapses in exercising); Exercise Habits_p = Self-Reported Habit Index – Exercise (higher scores indicates physical activity more frequent habit at post-treatment); Weight Loss Behaviors_p = Weight Loss and Self-Monitoring Behaviors Questionnaire (higher scores indicates more healthy weight loss behaviors at post-treatment); Group = Treatment Group; Conscientiousness = NEO Personality Inventory-3 Conscientiousness Domain (higher scores indicate more conscientious); Exercise Habits = Self-Reported Habit Index – Exercise (higher scores indicates physical activity more frequent habit at baseline); Weight Loss Behaviors = Weight Loss and Self-Monitoring Behaviors Questionnaire (higher scores indicates more healthy weight loss behaviors at baseline).
Table 7

*Multiple Regression Analyses for Predicting Weight Loss*

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Predictor</th>
<th>B</th>
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<th>β</th>
<th>T</th>
<th>P</th>
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<td></td>
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<td>.605</td>
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<tr>
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<td>Group</td>
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</tbody>
</table>

*Note.* Wgt loss = Percent weight loss (higher scores indicate weight gained); Impulsivity = Barrett Impulsivity Scale (higher scores indicate more impulsive); Conscientiousness = NEO Personality Inventory-3 Conscientiousness Domain (higher scores indicate more conscientious).
APPENDIX A. Weight Loss and Self-Monitoring Behaviors Questionnaire.

Please answer the following questions based on this past week. If this past week was not typical (i.e., you were sick or did something out of the ordinary) then answer based on a typical week. If you are not sure, please try to estimate as best as you can.

0 = 1 or fewer days a week
1 = 2 – 3 days a week
2 = 4 – 5 days a week
3 = 6 or more days a week

1. On average, how often do you plan your meals and snacks ahead of time?
2. On average, how often do you set aside time to do physical activity?
3. On average, how often do you track calories?
4. On average, how often do you measure the food on your plate (e.g., use a digital scale and/or a measuring cup to determine the quantity of food that you eat)?
5. On average, how often do you watch the portion sizes of what you’re eating?
6. On average, how often do you eat low-fat and/or low-calorie foods?
7. On average, how often do you snack on fruits and vegetables instead of high-calorie and/or high-fat foods?
8. On average, how often do you snack on sweets and/or desserts after a meal? R
9. On average, how often do you eat at a fast food restaurant (including drive thru, take out and convenience stores)? R
10. On average, how often do you incorporate exercise into your daily routine (e.g., taking the stairs instead of the elevator, parking your car further away, etc.)?

0 = 1 or fewer servings a day
1 = 2 – 3 servings a day
2 = 4 – 5 servings a day
3 = 6 or more servings a day

11. On average, how many servings of fruit (not including juices) do you eat?
12. On average, how many servings of vegetables (fresh, frozen or canned) do you eat?

0 = Never
1 = Rarely
2 = Sometimes
3 = Very Often
4 = Always

13. On average, how often do you shop for groceries from a list?
14. On average, how often do you follow a structured exercise routine (i.e., plan specifics about your exercise routine, including length and repetitions)?
15. On average, how often do you make up for missing a day of physical activity (i.e., by increasing your level of physical activity the next day, exercising for longer periods of time, etc.)?

*Note.* R indicates that the question is reversed coded.
APPENDIX B. Weight Loss Goals Questionnaire.

Please answer the following questions based on the past week. If this past week was not typical (i.e., you were sick or did something out of the ordinary) then answer based on a typical week. If you are not sure, please try to estimate as best as you can.

1. How difficult has it been to record your calories from foods and beverages? 1 through 7 scale, where 1 = not at all difficult and 7 = very difficult

2. How difficult has it been to record your activities or exercises that you’ve engaged in? 1 through 7 scale, where 1 = not at all difficult and 7 = very difficult

3. How difficult has it been to adhere to your eating goals (e.g., sticking to a specified amount of calories)? 1 through 7 scale, where 1 = not at all difficult and 7 = very difficult

4. How difficult has it been to adhere to your exercise goals (e.g., increasing your level of physical activity)? 1 through 7 scale, where 1 = not at all difficult and 7 = very difficult

5. In terms of your eating, how many times have you had a relapse (i.e., a point where you ate a lot more calories than you planned to)?

6. In terms of your physical activity, how many times have you had a relapse (i.e., a point where you did not exercise but wanted to)?

Please answer question 7 only if you’ve encountered a relapse in the past week.

7. How difficult has it been to overcome this setback and get back on track? 1 through 7 scale, where 1 = not at all difficult and 7 = very difficult
APPENDIX C. Barratt Impulsivity Scale (Patton, Stanford, & Barratt, 1995).

People differ in the ways they act and think in different situations. This is a test to measure some of the ways in which you act and think. Read through each statement and fill in the one answer that best describes you. Do not spend too much time on any statement. Answer quickly and honestly.

0 = Rarely / Never
1 = Occasionally
2 = Often
3 = Almost Always / Always

I plan tasks carefully.
I do things without thinking.
I make-up my mind quickly.
I am happy-go-lucky.
I don’t “pay attention.”
I have “racing” thoughts.
I plan trips well ahead of time.
I am self controlled.
I concentrate easily.
I save regularly.
I “squirm” at plays or lectures.
I am a careful thinker.
I plan for job security.
I say things without thinking.
I like to think about complex problems.
I change jobs.
I act “on impulse.”
I get easily bored when solving thought problems.
I act on the spur of the moment.
I am a steady thinker.
I change residences.
I buy things on impulse.
I can only think about one thing at a time.
I change hobbies.
I spend or charge more than I earn.
I often have extraneous thoughts when thinking.
I am more interested in the present than the future.
I am restless at the theater or lectures.
I like puzzles.
I am future oriented.
APPENDIX D. NEO Personality Inventory-3 Conscientiousness Scale (McCrae & John, 1992).

Due to copyright restrictions, we are not authorized to display this measure.

0 = Strongly disagree
1 = Moderately disagree
2 = Slightly disagree
3 = Neither disagree nor agree
4 = Slightly agree
5 = Moderately agree
6 = Strongly agree

Healthy eating is something...

I do frequently.
I do automatically.
I do without having to consciously remember.
that makes me feel weird if I do not do it.
I do without thinking.
that would require effort not to do it.
that belongs to my (daily, weekly, monthly) routine.
I start doing before I realize I'm doing it.
I would find hard not to do.
I have no need to think about doing.
that's typically "me."
I have been doing for a long time.

Exercise/Physical activity is something...

I do frequently.
I do automatically.
I do without having to consciously remember.
that makes me feel weird if I do not do it.
I do without thinking.
that would require effort not to do it.
that belongs to my (daily, weekly, monthly) routine.
I start doing before I realize I'm doing it.
I would find hard not to do.
I have no need to think about doing.
that's typically "me."
I have been doing for a long time.
DATE: September 17, 2012

TO: Robert Carels
FROM: Bowling Green State University Human Subjects Review Board

PROJECT TITLE: [300066-4] Weight Loss Program
SUBMISSION TYPE: Continuing Review

ACTION: APPROVED
APPROVAL DATE: October 1, 2012
EXPIRATION DATE: September 30, 2013
REVIEW TYPE: Expedited Review
REVIEW CATEGORY: Full Board Review Category

Thank you for your submission of Amendment/Modification materials for this project. The Bowling Green State University Human Subjects Review Board has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The final approved version of the consent document(s) is available as a published Board Document in the Review Details page. You must use the approved version of the consent document when obtaining consent from participants. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require that each participant receives a copy of the consent document.

Please note that you are responsible to conduct the study as approved by the HSRB. If you seek to make any changes in your project activities or procedures, those modifications must be approved by this committee prior to initiation. Please use the modification request form for this procedure.

You have been approved to enroll 750 participants. If you wish to enroll additional participants you must seek approval from the HSRB.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. All NON-COMPLIANCE issues or COMPLAINTS regarding this project must also be reported promptly to this office.

This approval expires on September 30, 2013. You will receive a continuing review notice before your project expires. If you wish to continue your work after the expiration date, your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date.

Good luck with your work. If you have any questions, please contact the Office of Research Compliance at 419-372-7716 or hsrb@bgsu.edu. Please include your project title and reference number in all correspondence regarding this project.
This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Bowling Green State University Human Subjects Review Board's records.