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Pretreatment Predictors of Weight Loss in a Comprehensive Behavioral Weight Loss Program

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Pretreatment Predictors of Weight Loss in a Comprehensive

Behavioral Weight Loss Program

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Abstract

Background: There is considerable variability in response to behavioral weight control treatment. Identifying pretreatment health behaviors that predict an individual's weight loss success has the potential to assist with assignment into more appropriate treatment settings (i.e., standard behavioral program versus comprehensive home environment program) that are likely to yield greater weight loss outcomes over time. Methods: Participants (N= 201; 48.9 ± 10.5 years; 78.1% women) enrolled in a study comparing a standard behavioral weight loss program (BWL; n=99) to a home-environment focused weight loss program (BWL+H; n=102) completed baseline questionnaires assessing individual control variables (i.e., dietary restraint, self-weighing) and control over the home environment (i.e., grocery shopping, meal preparation practices). Successful weight loss (SWL), defined as demonstrating a ≥5% weight loss at 18-months, was objectively measured. Logistic regression was used to identify significant predictors of SWL both in the overall sample and in each of the treatment conditions. Results: Less than half of all participants endorsed having moderate dietary restraint (45.7%), self-weighing at least 1 time per week (44.6%), being the primary grocery shopper (45.8%), or preparing the majority of meals at home (39.8%). Significant associations were observed among potential pretreatment predictors. Infrequent self-weighing was associated with eating meals away from home (r= .396, p <.01), and lower dietary restraint (r= -.221, p <.01). Preparing less than half of all meals at home was associated with poor dietary restraint (r= -.177, p<.05). 48.3% participants maintained SWL at 18-months (53.9% of BWL+H condition; 42.8% of BWL condition, p=.104). Logistic regression analyses revealed that none of the studied variables were associated with weight loss success in the full model, although race was a significant predictor of SWL (p<.05, OR=.697[.486-.999]). However, primary grocery shopper status was a significant predictor of

SWL among BWL+H participants (p<.05, OR=3.90 [1.26-12.035]), while preparing the majority of meals at home was a significant predictor of SWL in the BWL condition (p<.05, OR=.508 [.264-.976]). Discussion: Our results provide some evidence to support the importance of assessing novel home environment control variables, including grocery shopper status and meal preparation practices during the pretreatment phase, while recognizing the potential role of these variables in future behavioral weight loss programming.

Keywords: behavioral weight loss, individual control, home environmental control

Pretreatment Predictors of Weight Loss in a Comprehensive Behavioral Weight Loss Program

In 2009-2010, the prevalence of obesity (defined as a body mass index, BMI ≥30 kg/m^2) in the United States was 35.5% among adult men and 35.8% among adult women, with no significant change compared with 2003-2008. There are numerous medical consequences associated with obesity, as it is a risk factor for a variety of chronic conditions including diabetes, hypertension, high cholesterol, stroke, heart disease, certain cancers, and arthritis (Malnick & Knobler, 2006). Higher grades of obesity are associated with excess mortality, primarily from cardiovascular disease, diabetes, and certain cancers (Flegal, Graubard, Williamson, & Gail, 2007). Not surprisingly, estimates of the impact of obesity on United States health care costs are striking, ranging from $147—168 billion dollars per year (Cawley & Maclean, 2012). On an individual level, Cawley and Meyerhoefer (2012) reported that obesity raises annual medical costs by $2741 (in 2005 dollars). Modest weight loss reduces the risks associated with obesity-related disorders and diseases (i.e., Vogels, Diepvens, & Westerterp-Plantenga, 2005), therefore, successful prevention and treatment of obesity is likely to result in lower incidences of these diseases and lower health care costs (Bogers et al., 2010). Effective weight management programs are clearly needed to halt the obesity epidemic and reduce future physical and economic burdens.

Behavioral weight loss (BWL) treatment is considered the gold standard for individuals with a BMI between 25-40 kg/m^2. However, there are two major issues with existing BWL treatment – its cost and its variable impact particularly when considering long-term weight loss outcomes. While BWL treatment can offset the health care costs of obesity, this intensive approach also has significant costs including recruitment, intervention, and retention efforts. Individual- and group- level behavioral lifestyle intervention costs are not typically provided in

treatment outcome studies unless cost-efficacy is a primary or secondary aim; however, a few studies have provided cost comparisons between in-person and internet-based weight loss studies (Krukowski, Tilford, Harvey-Berino, & West, 2011; Bogers et al., 2010; Gustafson et al., 2009). As an example, one study by Krukowski and colleagues compared 6-months of an in-person group versus online group behavioral weight control program; all participants (n=161 in-person, n=162 online) were offered the same behavioral weight control program content (same dietary and physical activity goals, and behavioral strategies) to meet their target weight. After considering travel costs (null for online), materials, personnel costs, and fixed costs (e.g., space, utilities, equipment), the online group cost $59,982.55 over 6 months, averaging about $372.56 per-person, compared to nearly double that for the in-person total cost of $113,738.17, and average cost per-person of $706.45. Despite the fact that in-person behavioral interventions were more expensive than online interventions, the in-person intervention produced greater weight losses, so per kilogram costs are relative and average approximately $88.31 per kilogram of weight loss. While this is only one example, similar costs have been reported elsewhere if the length (i.e., 24 versus 16 weeks) and delivery (i.e., group versus individual) of the program are considered (e.g., Bogers et al., 2010; Gustasfon et al., 2009).

Further, while BWL treatments have been successful at producing short-term weight loss, their impact is variable and sustained weight loss is rarely achieved (e.g., Johnston et al., 2012; Stubbs et al., 2011; Vogels et al., 2005). In the example provided above (Krukowski et al., 2011), in-person participants had significantly greater weight losses at six months (-8.0 ± 6.1 kg) than internet participants (-5.5 ± 5.6 kg) but there was tremendous variability in treatment response (as demonstrated by the standard deviations). Other studies have reported similar variability in weight loss outcomes (i.e., Stubbs et al., 2011; Teixeira et al., 2005). The

variability in treatment response suggests that while existing treatments are somewhat effective, they can be expensive particularly if they produce minimal weight loss or even weight gain in some individuals. From a cost perspective, it would be ideal if pretreatment characteristics associated with weight loss success could be identified so that existing BWL treatment could be targeted to these individuals and alternative, perhaps more comprehensive treatment approaches could be developed for individuals who are unlikely to achieve significant weight loss in BWL.

Unfortunately, the literature on pretreatment predictors of weight loss success is mixed at best. Most studies have examined some combination of demographic variables (i.e., gender, ethnicity, SES, weight history), psychosocial variables (i.e., depression, perfectionism), and/or eating and exercise behaviors (e.g., Johnston, 2012; Stubbs et al., 2011; Fabricatore et al., 2009; Teixeira, Going, Sardinha, & Lohman, 2005). Of the demographic and psychosocial pretreatment predictors that have been most frequently considered, there appears to be some consensus that depressive symptomology (Johnston, 2012; Stubbs et al., 2011), early weight loss in treatment (e.g., Fabricatore et al., 2009; Teixeira et al., 2005), and social support (e.g., Johnston, 2012; Elfhag & Rössner, 2005; Teixeira et al., 2005; Williams, Grow, Freedman, Ryan, & Deci, 1996) impact weight loss and weight loss maintenance but the strength of these associations tend to vary from small to medium effects. In a comprehensive review of the literature, Teixeira and colleagues (2005) concluded that while fewer previous weight loss attempts was predictive of success, most baseline psychosocial and eating-related variables were not predictive of weight loss (e.g., mood, binge eating, disinhibited eating) or had not been sufficiently studied (e.g., body image, self-esteem, weight-related quality of life). Simply knowing how much an individual eats or exercises at baseline provides little information about how an individual may respond to treatment. In fact, most studies of pretreatment predictors

have only been able to account for 20-30% of the variance in their samples, according to a comprehensive review by Stubbs and colleagues (2011).

Numerous explanations have been posited as to why consistent pretreatment predictors have not emerged in the literature (see Johnston, 2012; Stubbs et al., 2011; or Teixeira et al., 2005 for recent reviews). The lack of consistent findings could be the result of imperfect measures of pretreatment characteristics. Eating and exercise measures are subject to numerous reporting biases and individuals entering treatment may be reluctant or unable to present an accurate report of their baseline state. The mixed reports in the literature may also be a reflection of the heterogeneity of overweight and obese individuals seeking weight loss treatment. For example, treatment-seeking adults tend to report medical and/or psychological co-morbidities that may influence pretreatment characteristics (i.e., diabetes, hypertension; depression, anxiety, respectively). Alternatively, demographic differences among treatment-seeking adults (i.e., gender, ethnicity, SES) may impact what treatment is available to or considered by the individual, which further adds to the complexities of understanding how particular pretreatment variables or behaviors may portend individual weight loss success.

Or, perhaps, the reason that consistent pretreatment predictors of weight loss success have not been identified is because the wrong variables have been examined. Most predictors studied to date have been demographic in nature and beyond the individual's control (e.g., age, gender, race) or psychosocial variables that are inherently unstable (e.g., depression status). The behavioral variables that have been explored have been largely limited to dietary intake and energy expenditure. Focusing on more targetable health behaviors that go beyond healthy eating and exercise, and that may be more amenable to change than fixed (i.e., demographic) or unstable variables (i.e. psychosocial), has the potential to contribute to the weight loss literature.

Moreover, the environmental context is now recognized as a key determinant of behavior in ecological and behavioral models of weight control (Gorin et al., 2011), so exploring behavioral factors that could be than be manipulated within the individual and their surrounding environment to influence long term weight loss success is an appropriate and necessary direction of study.

The present study examined four potential predictors of weight loss that have been understudied or not previously explored in the literature: dietary restraint behaviors, self-weighing frequency, grocery shopping habits, and meal preparation practices (see Figure 1 for a conceptual model). These variables were examined within the context of the Lifestyle Eating and Activity Program (LEAP) randomized controlled trial (Gorin et al., 2013) and share a common theme in that they all relate to behavioral control at either the personal (i.e., dietary restraint behaviors, self-weighing) or home environmental (i.e., grocery shopping habits, meal preparation practices) level. Relatively few studies have examined dietary restraint as a pretreatment predictor of weight loss success, and despite variability in the sample populations in which restraint has been tested (i.e., all male, all female, obese and non-obese, treatment studies), there is some indication that moderate dietary restraint is predictive of weight loss success and weight loss maintenance (e.g., Vogels, et al., 2005; Lejeune, Van Aggel-Leijssen, Van Baak, & Westerterp-Plantenga, 2003; Lindroos et al,. 1997; Pekkarinen, Takala, & Mustajoki, 1996). Self-monitoring, including self-weighing behaviors, is recognized in the obesity literature as the cornerstone of effective behavior change. Self-weighing has recently emerged as an important variable to consider for weight loss success, but has not been widely studied as a pretreatment predictor (e.g., Johnston 2012; Look AHEAD, 2010; Elfhag & Rössner, 2004; DPP, 2002). As reflected by their absence in the literature, grocery shopper status and meal preparation practices

have not been considered as pretreatment predictors of weight loss or weight loss maintenance. However, these home environment control variables should be carefully considered given their immediate influence over the food that is purchased and consumed by individuals seeking weight loss treatment.

Investigation of these new pretreatment predictors has the potential to inform future prevention and intervention efforts by highlighting the importance of their influence on weight loss outcomes. There is the potential to change, add, or strengthen certain aspects of existing weight loss programs for those who are assumed unlikely to succeed based on pretreatment characteristics, which may not only reduce intervention implementation costs, but also increase the likelihood of an individual's success in the tailored program and identify group(s) for which other programs are needed. By utilizing the LEAP trial (Gorin et al., 2013), the current study was uniquely positioned to explore new pretreatment predictors in the context of a standard behavioral weight loss program (BWL), while also testing whether these same behavioral variables would act similarly in a comprehensive weight-loss program (BWL+H) that targeted both an individual's behavior and his or her physical and social home environment.

The specific aims of the current study were to: (1) determine whether pretreatment behavioral factors of individual control (i.e., dietary restraint, self-weighing) and control over the home food environment (i.e., grocery shopper status, meal preparation practice) significantly predicted long-term weight loss success and (2) examine if these pretreatment behavioral factors differentially predicted weight loss success in participants who are engaged in a standard behavioral weight loss (BWL) program versus a comprehensive weight loss program designed to modify participants' physical and social home environment (BWL+H). The hypotheses that were tested included: (1) Higher levels of pretreatment dietary restraint, more frequent self-weighing,

being the primary grocery shopper, and eating the majority of meals at home would predict participants' long term weight loss success, regardless of treatment condition; (2) Not endorsing primary grocery shopper status would have more impact on individuals in the BWL group, who were expected to demonstrate poorer weight loss success than BWL+H group.

Methods

Participants

Participants were recruited through advertisements in local media and direct mailings in the Providence, Rhode Island area. To be eligible, individuals had to be between 21 and 70 years old, have a body mass index (BMI) between 25 and 50 kg/m^2, and have a household member willing to participate in the study as a support partner. Individuals were excluded from participation if they reported a heart condition, chest pain during periods of activity or rest, loss of consciousness, being unable to walk two blocks without stopping, current participation in another weight-loss program and/or taking weight-loss medication, current pregnancy or planning on becoming pregnant in the next 18 months, or any condition in the judgment of the research team made it unlikely the individual would complete the study protocol. Individuals endorsing joint problems, prescription medication usage, or other conditions that could limit exercise were required to obtain written physician consent to participate.

Procedure

Participants were randomly assigned to one of two 18-month behavioral weight-control programs: BWL, a standard behavioral weight loss program, or BWL+H, a home-environment focused weight loss program. In BWL, only participants received treatment; in BWL+H both participants and partners received treatment. Partners are not included in the present analyses and are not further discussed. Participants in both conditions were assessed at baseline, 6, and 18

months via clinic and home visits. The primary outcome was body weight, measured in street clothes with shoes removed, using a calibrated digital scale (Tanita BWB 800) and recorded to the nearest 0.1 kg. Height was measured at baseline to the nearest centimeter using a calibrated, wall-mounted stadiometer. BMI was calculated as kg/m^2. Demographic characteristics were obtained by self-report questionnaires which took one hour to complete. Weight data were available from 92.0% of participants at 18 months. BWL+H participants were more likely to have complete weight data than BWL participants (97.1% of BWL+H vs. 85.9% BWL, $p = .004$) and participants with complete weight data were significantly older ($p < .0001$) and had more years of formal schooling ($p = .024$) than participants with missing weight data (Gorin et al., 2013). In the current study, missing weights at follow-up were replaced with baseline weight (as in the original study) and intent to treatment analyses are reported. Weight loss success was defined as a reduction of ≥5% from initial weight at the 18-month follow-up assessment. This definition of weight loss success has been used in numerous other weight loss studies (e.g., Gorin et al., 2013; Stubbs et al., 2011; Fabricatore et al., 2009; Wadden et al., 2005) because it is associated with clinically meaningful health improvements.

Measures

The present study used a sub-sample of the full assessment battery to assess the behavioral predictors of interest (dietary restraint, self-weighing, grocery shopper status, and meal preparation practices).

Dietary restraint. One item from Stunkard & Messick's 51-item Three Factor Eating Questionnaire (TFEQ; 1985) was included to assess dietary restraint. The TFEQ is comprised of 36 true/false statements (e.g., 'I eat anything I want, any time I want') and 15 items with varying Likert scale response sets. The item used for the current study assessed dietary restraint with the

following prompt: "On a scale of 1 to 6, where 1 means no restraint in eating (eat whatever you want, whenever you want it) and 6 means total restraint (constantly limiting food intake and never "giving in"), what number would you give yourself?" and participants were instructed to select only one answer that applies best to their current eating behaviors: 1 = 'eat whatever you want, whenever you want it;' 2 = 'usually eat whatever you want, whenever you want it;' 3 = 'often eat whatever you want, whenever you want it;' 4 = 'often limit food intake, but often 'give in;'' 5 = 'usually limit food intake, rarely 'give in;'' 6 = 'constantly limited food intake, never 'giving in.'' Scores between 1-3 indicate a decreasing lack of dietary restraint, respectively, whereas scores between 4-6 indicate increasing to severe dietary restraint, respectively. The reliability and validity of the original TFEQ have been tested and demonstrated in numerous studies, but there is mixed support for the three-factor model and thus one item was selected for inclusion as has been done in prior studies. As supported by previous research, dietary restraint responses indicating "often or usually limit food intake" were combined to create a "moderate dietary restraint" variable (see Karlsson, Persson, Sjostrom, & Sullivan, 2000; Allison, Kalinsky, & Gorman, 1992; Stunkard & Messick, 1985).

Self-weighing. A standardized weight loss history questionnaire that has been used across several weight management studies (e.g., Phelan et al., 2009; Wadden et al., 2005) was used to assess self-weighing behaviors with one item: "During the past month, how often did you weigh yourself" with a 7-point Likert scale. The response options include: 1= several times/day, 2 = one time/day, 3= several times/week, 4= one time/week, 5= less than 1 time/week, 6 = less than 1 time/month, and 7= never weighed myself.

Grocery shopping and meal preparation practices. The CDC's National Health and Nutrition Examination Survey (NHANES): Flexible Consumer Behavior Survey (FCBS) was

used to assess whether the participants were the primary grocery shoppers in their home, and how often meals were prepared at home (Centers for Disease Control and Prevention, 2009). One item from the FCBS assessed whether or not the participant was the primary food shopper in the home, with a yes or no response option. Two items from the Center for Disease Control and Prevention (CDC) Flexible Consumer Behavior Survey (FCBS) were collapsed to create a 'meal preparation' variable for the purposes of this study. The items ask the participant to indicate the number of days a week he or she eats out at fast food and other restaurants for breakfast, lunch, and dinner (separately). Responses to these items were summed to categorize participants as 'predominately eating at home,' 'equal eating at home and restaurants,' and 'predominately eating at restaurants' if participants indicated eating ≥75% of all meals at home, 74-26% of all meals at home, or ≤ 25% of all meals at home, respectively

Data Analytic Plan

The primary outcome was percent (%) weight change from baseline to 18 months. A participant was considered to achieve successful weight loss (SWL) if he or she demonstrated ≥ 5% weight loss by the 18-month follow-up. All other participants were considered to have achieved unsuccessful weight loss (USWL). A correlation matrix of all predictors and multicollinearity diagnostics between predictor variables, and correlations between predictor variables and the dependent variable (% change in weight at follow up) were assessed prior to conducting the analyses. Statistical analyses were performed using Statistical Package for the Social Sciences, Release 21.0.0 (SPSS, Inc., 2012, Armonk, NY, www.spss.com). Demographic differences between SWL and USWL, as well as between BWL and BWL+H participants were examined using chi-square or independent t-tests.

Multivariate models were constructed to examine the relationship between specific pretreatment behavioral predictors and 18-month weight loss. Logistic regression analyses, adjusted for demographic differences, were conducted to identify whether or not specific behavioral variables (dietary restraint, self-weighing, grocery shopping, and meal preparation) were significant independent predictors of weight loss success at 18-months. Block 0 of the regression analysis included demographic variables (gender, race, age, objective baseline weight), and intervention group status. Block 1 introduced the four pretreatment behaviors of interest, dietary restraint, self-weighing behavior, grocery shopper status, and meal preparation practices to the model. If the behavioral variables were significantly related to 18-month weight outcomes, those variables were evaluated in terms of their independent contribution to the model R^2. To assess the relationship between specific pretreatment behavioral predictors and 18-month weight loss by intervention group status (BWL+H vs BWL), multivariate models were constructed using logistic regression to assess whether or not specific behavioral variables (dietary restraint, self-weighing, grocery shopping, and meal preparation) were differentially predictive of weight loss success at 18-months based on intervention group status.

Power Analysis

Power to assess both research questions was calculated assuming similar size effects between pretreatment predictors and weight loss (i.e., small to medium size effects) as reported in the existing pretreatment literature (e.g., Johnston, 2012; Stubbs et al., 2011; Teixeira et al., 2005). The sample size of the current study (n = 201) provides sufficient power (1-β = .80, α=.05) to detect a moderate size effect (d=.2-.3) between the four pretreatment predictors and percent change in body weight at 18-months for specific aim 1. This sample size was also sufficient to detect group differences (SWL and USWL; BWL and BWL+H) within groups

regarding pretreatment predictors and long term weight loss with moderate to large size effects (d= .4-.5) assuming 1-β = .80 and α=.05, according to Cohen's power tables (1988) which require 64 participants per group to detect significant differences (BWL *n* = 99; BWL+H *n* = 102) based on intervention group status for specific aim 2.

Results

Participants

A total of 1880 individuals were screened by telephone to determine initial eligibility. If an individual was eligible, he or she was asked to provide contact information for their partner who was then screened for eligibility. Eligible pairs were invited to attend an orientation at the clinic where the study was described in detail and informed consent was obtained (Gorin et al., 2013). 201 participants were randomized and included in the original and current study (BWL, *n* = 99; BWL+H, *n*= 102). The current sample was predominately female (78.1%; *n* = 157), white (82.4%; *n* = 164), the mean age was 48.9 (±10.5), and the baseline BMI of all participants was 36.4 kg/m^2 (±6.1) (Gorin et al., 2013).

Pretreatment behaviors of interest

Correlations between baseline variables

As illustrated in Table 1, in the overall sample regardless of intervention group status and weight loss success, infrequent self-weighing was associated with eating meals away from home (r= .396, p <.01), and lower dietary restraint (r= -.221, p <.01). Preparing less than half of all meals at home was associated with poor dietary restraint (r= -.177, p<.05).

Frequency of pretreatment behaviors

In the overall sample, 45.7% of participants reported moderate dietary restraint, 44.6% endorsed self-weighing at least once per week, 45.8% reported being the primary grocery

shopper, and 39.8% endorsed preparing at least 75% of meals at home (see Table 1). These frequencies did not significantly differ by treatment condition.

Relationship between pretreatment predictors and weight loss outcomes

In the overall sample, 48.3% (*n*=97) of all participants were successful weight losers (≥5% SWL) at 18-months. These participants lost on average 13.5±10.7 kgs at 18 months compared to only .232±4.1 kgs lost on average for USWLs (n=104; p<.01).

SWL vs USWL

SWL (*n*=97*)* were more likely to be white, older aged, and endorse being the primary grocery shopper and meal preparer than unsuccessful weight losers. USWL (*n*=104*)* were more likely to be female, black, and less likely to be the primary grocery shopper or meal preparer. (Table 2). Although mean differences between SWL and USWL do exist, they did not reach statistical significance.

BWL vs. BWL+H

BWL+ H participants were younger than BWL participants [mean starting age: 47.51 (±11.34) vs 50.39 (±9.34), respectively, p<.05] but did not significantly differ on other demographic or any of the pre-treatment variables of interest. Although SWL rates did not differ significantly between treatment conditions, some variability between conditions was observed with 53.9% (n=55) of participants in the BWL+H condition demonstrating ≥5% SWL, compared to 42.8% (n=42) in the BWL condition at 18-months.

Multivariate Analyses

Logistic regression analyses showed that none of the four behavioral variables of interest were significant predictors of long-term weight loss success across all participants, although one demographic variable, race, did emerge as a significant predictor of SWL (p<.05) (Table 3).

However, logistic regression analyses by intervention group status did reveal significant pretreatment predictors by condition (BWL+H vs BWL; see Table 4). Primary grocery shopper status among BWL+H participants was a significant predictor of SWL (p=.018, OR=3.90 [1.26-12.035]), while preparing the majority of meals at home was a significant predictor of SWL in the BWL condition (p<.05, OR=.508 [.264-.976]).

Discussion

Many behavioral weight loss interventions have demonstrated initial efficacy with clinically significant weight losses at 6-12 months, but weight regain is common in the long-term follow-up period (Gorin et al., 2013; Johnston, 2012; Stubbs et al., 2011; Teixeira et al., 2005). There is, however, considerable variability in this treatment response with some individuals able to achieve and maintain losses and others showing no weight loss or even weight gain. Understanding who is likely to respond to behavioral weight loss treatment has the potential to tailor programming in such a way that maximizes treatment response. Much of the existing pretreatment literature focuses on demographic (i.e., gender, ethnicity, SES, weight history), psychosocial (i.e., depression, perfectionism), and eating and exercise behaviors (e.g., Johnston, 2012; Stubbs et al., 2011; Teixeira, Going, Sardinha, & Lohman, 2005) as predictors of weight loss success with mixed findings. The novel aspect of the present study is that it focused on long-term weight loss success and explored behavioral control variables that might distinguish individuals who were successful weight losers (≥5% weight loss at 18-months) from those who were not. To our knowledge, this is the first study to consider these specific individual control (i.e., dietary restraint and self-weighing) and home environment control (i.e., grocery shopper status, meal preparation practices) variables together as pretreatment predictors of weight loss.

The primary conclusion that can be drawn from this research is that identifying

pretreatment predictors of SWL remains an elusive goal. As is common in the pretreatment predictor literature, we failed to find significant baseline predictors of 18-month weight loss success regardless of treatment condition. Our null finding regarding dietary restraint as a pretreatment predictor of weight loss is not alone in the literature (e.g., Stubbs et al., 2011; Teixeira et al., 2005) and suggests that more work needs to be done to understand the relationship between dietary restraint and weight loss success. One possible explanation is that a curvilinear relationship may be present, where low and too high of levels of dietary restraint are harmful but moderate restraint is helpful. In contrast to some published reports (i.e., Look AHEAD Group, 2010; DPP, 2002), there was a non-significant trend suggesting that unsuccessful weight losers were more likely to self-weigh at least once per week compared to successful weight losers. It may be that change in self-weighing frequency over the course of weight loss treatment is more important to consider than baseline levels. There is no existing literature on the relationship between grocery shopper status, meal preparation practices, and weight loss success, as these were novel predictors of study. Our null findings, while disappointing, will make a contribution to the literature in that these variables have not been previously explored. Despite the fact that none of the studied pretreatment variables were associated with weight loss success, race was a significant predictor of SWL. The finding should be interpreted with caution, however, in light of the limited overall diversity of the sample. Ultimately, the findings regarding the relationship between pretreatment predictors and weight loss success were counter-intuitive to what might be expected and are thus difficult to interpret.

Given the importance of personal and environmental control in weight loss, we expected to find more consistent predictors of weight loss in this sample. From a clinical perspective, it seems clear that being the food shopper and preparing the majority of meals at home would be

important determinants of weight loss success regardless of treatment condition. If an individual does not have control over the food coming into their house and whether or not healthy meals are prepared, one might expect their weight loss to be tempered. Unfortunately, these hypothesized relationships were not supported in the full sample, although environment control variables did differentially impact weight loss success by treatment condition. Specifically, we found that primary grocery shopper status was a significant predictor of SWL among BWL+H participants but not BWL participants. This was unexpected given that in BWL+H both the participant and a partner from their home (most often a spouse) participated in treatment together. It would seem that being the primary grocery shopper would be less meaningful in this condition although our results suggest otherwise. We also found that preparing the majority of meals at home was a significant predictor of SWL in the BWL condition but not BWL+H. It may be that eating at home and controlling the types of food served is particularly important in standard BWL because other household members may not be following the same meal plan (unlike in BWL+H where participants and partners were losing weight together) and may order tempting foods when consuming meals away from home, thus "sabotaging" weight loss success. More research is needed to better understand these relationships. Further, the significant correlations between individual control and home environment control variables suggest that potentially harmful behaviors cluster together and may set the stage for future weight management problems. Individuals who self-weighed less frequently also reported eating more meals away from home, and endorsed less dietary restraint. Those who were not the primary meal preparer also reported lower levels of dietary restraint. One might expect then, that over time, these patterns may negatively impact weight loss or weight loss maintenance efforts, due to a lack of personal or home environmental control.

While our findings add to the growing literature examining pretreatment predictors of weight loss, this study had considerable limitations as well. Limited racial and ethnic diversity in adult, weight loss treatment-seeking samples is common; the current study was no exception, despite efforts to recruit a more diverse sample. However, the demographics of successful weight losers in this sample were consistent with the existing literature (e.g., Johnston, 2012; Stubbs et al., 2011; Teixeira et al., 2005). The majority of weight loss treatment samples remain predominately white, which should be cause for significant concern given the higher prevalence of overweight and obesity among minority groups. Studies that have been successful in recruiting more diverse samples continue to find distinct differences between whites and ethnic minority groups on a variety of dimensions that not only limits the generalizability of the majority of existing literature, but may in fact be detrimental to those in ethnic minority groups who do or do not seek treatment for weight loss (Grilo, Lozano, & Masheb, 2005). In support of that notion, one might consider that black women were more likely to be unsuccessful long-term weight losers in the current study as well, despite a lack of diversity and relatively small sample. However, this study was not powered to look at ethnic differences, and thus further analyses were not conducted. Second, this study did not examine changes in behaviors of interest over time, but rather considered how baseline pretreatment behaviors may predict long-term weight loss outcomes. Assessing longitudinal changes in dietary restraint, self-weighing, grocery shopping habits, and meal preparation practices as they relate to outcomes may provide additional insight into the influence of these behaviors, or of the intervention manipulation (in the home environment condition), on outcomes. Another limitation in this study was its reliance on self-report measures. While we had objective height and weight data to ensure accuracy in computing BMI and tracking weight loss over time, the four behaviors of interest, dietary

restraint, self-weighing, grocery shopping status and meal preparation practices were all classified via self-report measures as is commonplace in the literature. Lastly, although ≥5% loss is a clinically valid cut point of SWL, the inclusion of SWL as a dichotomous, as opposed to a continuous outcome variable, may be considered a potential limitation of this study.

Our results provide further evidence that individuals seeking weight loss treatment have minimal control over the types of food being purchased for the home, while highlighting the potential importance of these variables for SWL. As such, interventions that include the primary grocery shopper and/or meal preparer in treatment might yield greater weight losses over time, particularly those that incorporate changes to the physical home environment. As recommended by Stubbs et al. (2011), treatments need to develop a more individualized approach that is sensitive to patients' needs and individual differences, which requires measuring and predicting patterns of intra-individual behavior variations associated with weight loss and its maintenance. Further exploration of pretreatment predictors could have important implications for researchers, clinicians, and all overweight and obese individuals who are interested in weight loss treatment, by providing support for specific health behaviors to incorporate and promote at both the intervention- and individual- level of weight management. Gaining a better understanding of the heterogeneity of pretreatment predictor findings to date and continuing this timely work has the potential to assist with the assignment of individuals' with weight loss goals into more appropriate treatment settings (i.e., standard behavioral program versus comprehensive home environment program) that are likely to yield greater weight loss outcomes over time, as a result of specific pretreatment health behaviors. Continuing to explore individual and home environment behavioral control variables that moderate weight loss outcomes may inform more targeted, and thus potentially more cost effective, tailored weight loss and weight maintenance

interventions in the future.

Figure 1. Conceptual Model

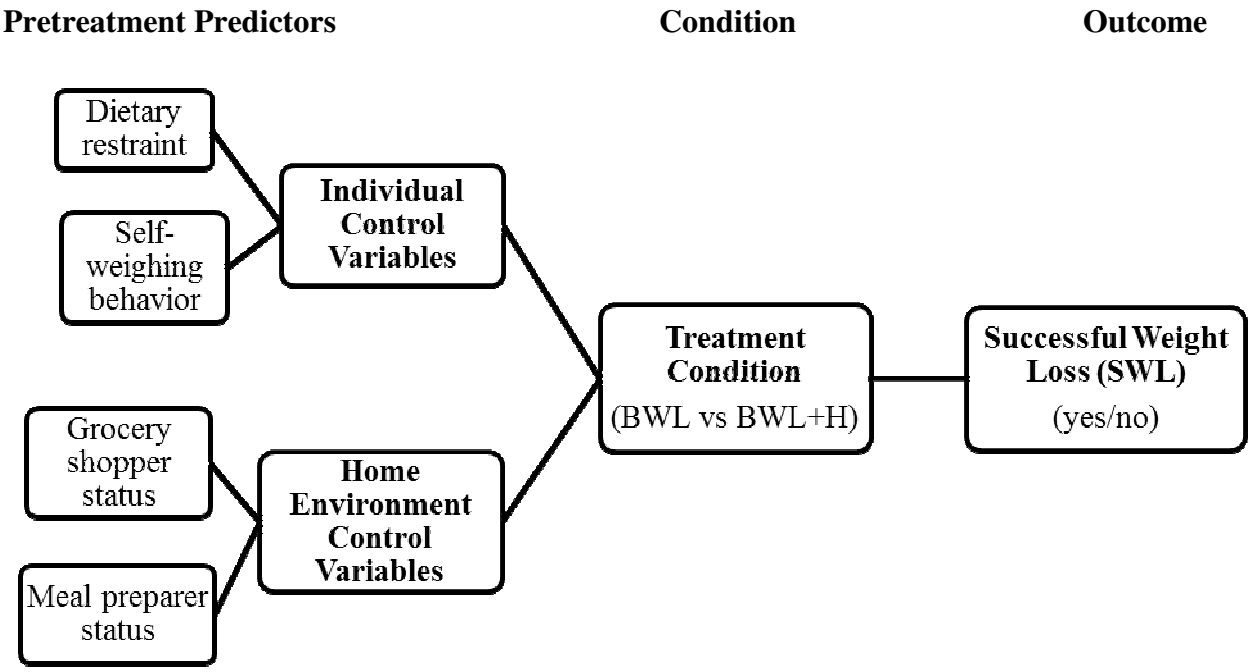

Table 1

Pretreatment Behavior Variables, Frequencies and Correlations (n=201)

Variables	Frequency (%)	1	2	3	4
1. TFEQ: Dietary Restraint	45.7	--			
2. Self-Weighing Frequency	44.6	-.221**	--		
3. FCBS: Grocery Shopper	45.8	.101	-.083	--	
4. FCBS: Meal Preparer	39.8	-.177*	.396**	-.070	--

Note: ***p< 0.01, *p< 0.05*

Table 2
Baseline Characteristics of Successful Weight Losers versus Unsuccessful Weight Losers

	Participants (n=201)					
	SWL (n=97)			USWL (n=104)		
Variables	n (%)	M	SD	n (%)	M	SD
Demographics						
Female	73 (75.3)	--	--	84 (80.8)	--	--
White, non-Hispanic	86 (88.7)	--	--	78 (75)	--	--
Black or African American	9 (9.3)	--	--	15 (14.4)	--	--
American Indian/Alaskan Native	1 (1.0)	--	--	1 (1)	--	--
Other	1 (1.0)	--	--	8 (7.7)	--	--
Age	--	50.45	9.49	--	47.51	11.18
Body Mass Index (kg/m^2)	--	36.66	6.41	--	37.90	6.14
Group assignment (BWL+H)	55 (53.9)	--	--	47 (46.1)	--	--
Group assignment (BWL)	42 (42.4)	--	--	57 (57.6)	--	--
Behaviors						
Self-weigh at least 1x/week	36 (45)	--	--	39 (49.3)	--	--
TFEQ: Some dietary restraint	38 (39.2)	--	--	42 (40.3)	--	--
FCBS: Primary grocery shopper	47 (48.5)	--	--	45 (43.3)	--	--
FCBS: Primary meal preparer	41 (42.3)	--	--	39 (37.5)	--	--
18-month weight loss (kg)		13.49**	10.70		.232**	4.13

*Note: **p<.01*

Table 3

Summary of Logistic Regression Analyses Predicting SWL (n=201)

Predictors	B	S.E.	*p*	e^B
Gender	.536	.587	.380	1.674
Race	-.362	.018	.049*	.697
Age	.019	.019	.336	1.019
Baseline weight	-.007	.004	.111	.993
Intervention group status	-.573	.381	.133	.564
Dietary restraint	.158	.196	.422	1.171
Self-weighing behavior	0.43	.119	.715	1.044
Grocery shopper status	.357	.460	.437	1.430
Meal preparation practices	-.128	.229	.313	.576
Constant	-.010	1.694	.995	.990
X^2	15.087			
df	9			

*Note: *p<.05*

Table 4
Summary of Logistic Regression Analyses Predicting SWL by Intervention Group (n=201)

	BWL+H *(n=102)*			BWL *(n=99)*		
Predictors	B (±S.E.)	*p*	e^B	B (±S.E.)	*p*	e^B
TFEQ: Dietary restraint	.410 (±0.16)	.366	.867	.139 (±0.25)	.577	1.156
Self-weighing	-.143 (±0.30)	.177	1.507	.145 (±0.17)	.399	1.149
FCBS: Grocery shopper	1.360 (±0.58)*	.018	3.896	-.601 (±0.57)	.293	.549
FCBS: Meal preparer	.208 (±0.33)	.530	1.231	-.678 (±0.33)*	.042	.508
Constant	-1.632 (±1.42)	.251	.196	-.412 (±1.24)	.293	.663
X^2	9.578			5.651		
df	4			4		

*Note: *p<.05*

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