

BARRIERS TO WEIGHT LOSS IN A STEPPED-CARE APPROACH TO BEHAVIORAL
WEIGHT LOSS TREATMENT

by

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Over two-thirds of the United States' adult population are overweight or obese, and these numbers continue to grow (Ogden, Carroll, Kit, & Flegal, 2014). Obesity is a disease that is a common comorbidity with other serious health conditions, including heart disease and diabetes (National Heart, Lung, and Blood Institute, 2012; Mokdad et al., 2003). Behavioral weight loss treatments (BWL) are typically the treatment of choice in cases other than extreme obesity (Miller, Koceja, & Hamilton, 1997). A more recent innovation in BWL research has been the application of stepped-care principles. A stepped-care approach typically begins with treatment that is low-intensity. For individuals who do not meet treatment goals after a predefined period, the intensity of treatment is increased (Watzke et al., 2014). Nevertheless, barriers to weight loss and weight loss maintenance are poorly understood. The current study aimed to examine barriers, depressive symptoms, and social support at four different time points to identify contributing factors to poor weight loss outcomes, attrition, and the need for stepped-care in a behavioral weight loss intervention. Fifty-three individuals ($M_{\text{BMI}}=35.6$, $SD_{\text{BMI}}=6.4$) were recruited for the stepped-care behavioral weight loss intervention. Social pressure, food craving, stress and depression, and cost of diet barriers reported during the current intervention were related to attrition, stepped-care need, and weight loss. Interestingly, greater helpfulness and

frequency of weight loss support were related to attrition, greater stepped-care need, and worse weight loss outcomes. It is important for future research to improve assessment of barriers to weight loss. Additionally, future weight loss interventions should consider the current findings, especially teaching skills to cope with social pressure and food cravings.

BARRIERS TO WEIGHT LOSS IN A STEPPED-CARE APPROACH TO BEHAVIORAL
WEIGHT LOSS TREATMENT

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Introduction

Obesity

In the United States, the obesity epidemic is a significant public health crisis. Over one-third (34.9%) of adults are obese (BMI \geq 30) and 68.5% of adults are either overweight or obese (BMI $>$ 25; Ogden, Carroll, Kit, & Flegal, 2014). Obesity contributes to \$113.9 billion of direct medical expenses for overweight and obese individuals (Tsai, Williamson, & Glick, 2011).

Coronary heart disease, high blood pressure, stroke, type 2 diabetes, cancer, high cholesterol, and asthma are among the poor health conditions associated with obesity (National Heart, Lung, and Blood Institute, 2012; Mokdad et al., 2003). Obesity leads to premature death; in fact, the younger a person with obesity is, the more years of life that are lost (Fontaine, Redden, Wang, Westfall, & Allison, 2003). Race is also a significant factor in premature death associated with obesity, with black individuals at a lower risk. Life expectancy begins to decrease for white men at a BMI of 26-27 and for white women at a BMI of 28-29, while life expectancy does not decrease until BMI 32-33 for black men and 38-39 for black women (Fontaine et al., 2003). For both races, age was negatively correlated with the number of years of life lost. Beyond health concerns, individuals with obesity are more likely to experience symptoms of depression than are individuals of normal weight (van Hout, van Oudheusden, & van Heck, 2004) and are often the targets of weight stigma (Puhl & Heuer, 2009).

While excess weight contributes to numerous negative health conditions, as little as a 5-10% weight loss may reverse many of the serious physical health risks associated with obesity (Perri & Corsica, 2002; Pi-Sunyer, 1996). For example, the Diabetes Prevention Program (DPP) demonstrated that weight loss and physical activity could significantly reduce the risk of developing diabetes (Diabetes Prevention Program Research Group, 2002). Participants were

randomized to one of three conditions: participation in a lifestyle intervention, prescription of metformin medication, or the delivery of standard lifestyle recommendations (placebo group). The DPP intensive lifestyle intervention group was prescribed a low-fat, low-calorie diet, and a minimum of 150 minutes of physical activity per week with the weight loss goal of 7.0% from their starting weight. The behavioral intervention resulted in 2.0 kg greater weight loss and 39% lower chance of developing diabetes than the diabetes medication metformin group; the behavioral intervention resulted in 5.5 kg greater weight loss and 58% lower chance of developing diabetes than the standard lifestyle recommendations “placebo” group (Diabetes Prevention Program Research Group, 2002).

Weight Loss Treatments

There are various weight loss treatment options, which range from low intensity traditional self-help diet books (Butryn, Kerrigan, & Kelly, 2012) to moderately intense behavioral weight loss treatments to highly invasive bariatric surgery. Self-initiated dieting is a more popular approach to weight loss than is enrolling in a structured behavioral treatment; 58% of men and 63% of women trying to lose weight will diet via caloric restriction while only 3% of men and 5% of women will participate in a weight loss program (Kruger, Galuska, Serdula, & Jones, 2004). Higher BMI in women was found to be related to a greater number of dieting attempts, which were often unsuccessful (Ikeda, Lyons, Schwartzman, & Mitchell, 2004). There are several contributors to the failure of dieting attempts, including dichotomous thinking, food cravings, and viewing dieting as a short-term weight loss strategy (Buchanan & Sheffield, 2015). While poorly understood, biological factors contribute to unsuccessful weight loss through dieting as well (Brownell, 1991).

Bariatric surgery has proven to be a successful method for individuals with extreme obesity (BMI \geq 40 kg/m²; Pories, 2008). Recipients lose about two-thirds of their excess bodyweight and are successful at achieving long-term weight loss maintenance (Latifi, Kellum, De Maria, & Sugerman, 2002). Although bariatric surgery can significantly reduce the risks related to diabetes and cardiovascular disease, there are potential serious complications involved with this major surgery, including excessive bleeding and anemia, and uncomfortable side effects, such as dumping syndrome (Svane & Madsbad, 2014). Additionally, bariatric surgery requires strict behavioral and dietary modifications before and after surgery to achieve significant weight loss success and prevent complications (Collazo-Clavell, Clark, McAlpine, & Jensen, 2006).

Therefore, given the cost and risks associated with bariatric surgery, behavioral weight loss treatments (BWL) are typically the treatment of choice in cases other than extreme obesity (Miller, Koceja, & Hamilton, 1997). While BWL vary, most share common treatment features and they tend to be low cost and low risk relative to bariatric surgery (Jeffery et al., 1993). BWLs are often delivered in a small group or individual format on a weekly basis for an average duration of six months (Frutchey & Carels, 2014), providing weight loss participants with regular provider contact and social support. They strive to modify behavior related to weight, namely dietary intake and physical activity levels, to create a modest caloric deficit (500-1000 kcal/day) and a 1-2-pound weight loss per week. Self-monitoring of caloric intake and expenditure is often considered a cornerstone of BWL and is believed to be key to its success (Wing, 2002).

Over time, some BWL examined whether structured plans for diet modification, including providing participants with a meal plan or with meal replacements, improved treatment

outcomes. A study with overweight or obese adults (BMI 25-40 kg/m²) with type 2 diabetes found that those on a portion-controlled diet consisting of meal replacements lost 3.14% more weight and had greater adherence to the program than participants following standard weight loss recommendations, although respective attrition rates, 42.6% and 70.7%, were high (Cheskin et al., 2008). In similar research, 100 participants (BMI 25-40 kg/m²) were randomized to either a restricted diet with all conventional foods or an isocaloric restricted diet with two meal and two snack replacements and participated in a three-month weight loss program followed by a 24-month maintenance phase (Ditschuneit, Flechtner-Mors, Johnson, & Adler, 1999). During the 24-month maintenance phase all participants were on a restricted diet plan with one meal and one snack replacement per day. Participants who received meal replacements during the weight loss phase lost a significant 6.3% more weight after the three-month program and lost a significant 5.4% more weight after the total 27 months than the participants who did not receive any meal replacements during the weight loss phase (Ditschuneit et al., 1999).

In addition to making changes to their diets, participants in a standard BWLT also strive to increase physical activity (Wing, 2002). Increasing physical activity is not only healthy, but also aids in the creation of daily caloric deficit (Frutchey & Carels, 2014). Physical activity goals may be in the form of minutes of exercise per week or number of daily or weekly steps measured by a pedometer/accelerometer. Research indicates that the combination of modifying diet and exercise together is more effective than engaging in diet or exercise changes alone for both weight loss and weight loss maintenance (Curioni & Lourenço, 2005).

A typical behavioral weight loss program leads to a 7-10% weight loss over the course of 6 months (Wadden, 2006). Unfortunately, weight gain following treatment is common (Vink, Roumans, Arkenbosch, Mariman, & van Baak, 2016); typically, nearly one half of the lost

weight is regained during the year after the completion of a weight loss program (Kramer, Jeffery, Snell, & Forster, 1986; Jeffery et al., 2000). Efficient and successful maintenance interventions have yet to be developed (Svetkey et al., 2008).

A more recent innovation in BWLT research has been the application of stepped-care principles. A stepped-care approach typically begins with treatment that is low-intensity. For individuals who do not meet treatment goals after a predefined period, the intensity of treatment is increased (Watzke et al., 2014). This model has the potential to promote a cost-effective approach to treatment by only allocating more resources to the individuals who require more intensive care, as opposed to traditional BWLT that deliver the same treatment to all participants.

Evidence from several small scale stepped-care weight loss trials that have been conducted to date suggest that stepped-care can improve treatment outcomes. A randomized trial compared a traditional BWLT program to a BWLT using problem-solving therapy as the stepped-up care if weight loss participants ($N = 44$, $BMI > 30 \text{ kg/m}^2$) failed to meet treatment goals (e.g., lose $> 1\%$ bodyweight by week 3; Carels et al., 2005). Twice as many participants who received the stepped-up care achieved the end-of-treatment goal of an 8% weight loss than the participants who did not receive the therapy. Further support for the effectiveness of the stepped-care model for BWLT was found in a randomized control trial by Carels and colleagues (2007) using motivational interviewing as the stepped-up care. Of the participants ($n = 55$, $BMI \geq 30 \text{ kg/m}^2$) who did not meet treatment goals (e.g., lose 1.25% bodyweight by the third week), the ones who received the stepped-up treatment of motivational interviewing lost nearly twice the amount of weight as the ones who did not receive the stepped-up treatment.

Although standard group-based or individual BWLT have demonstrated their effectiveness, they can be costly to provide to all participants. Therefore, low intensity

interventions, such as self-help, represent a potentially good entry-level treatment. A treatment is considered self-help if the individual autonomously works toward their weight loss goals with minimal support or accountability (Latner & Wilson, 2007). In one study, self-help was less effective than the commercial program Weight Watchers, which resulted in an average of 4kg greater weight loss than the self-help group over 26 weeks (Heshka et al., 2000). However, a review of self-help interventions for weight loss in overweight and obese samples indicated that self-help interventions produced more effective weight loss (over 4 pounds on average) and behavior change (i.e., self-monitoring) outcomes when compared with control groups receiving no treatment at 6 months (Hartmann-Boyce, Jebb, Fletcher, & Aveyard, 2015). Therefore, while self-help is less effective than a program providing more support and resources, weight loss can be achieved through this low-cost method.

The addition of stepped-care to self-help treatment approaches have also been explored. For example, in one low-intensity stepped-care study, Carels and colleagues (2009) used the LEARN Program for Weight Management as a self-help guide, and stepped up qualified participants to group therapy if they were unable to achieve a 2.5% weight loss. The difference between the 4.4% weight loss of the self-help group that did not require stepped-care and the 2.3% weight loss of the stepped-up group over the course of the 12-week second phase of the intervention approached significance ($p = .06$). The researchers concluded that receiving the more intense treatment did not result in more successful weight loss than the participants who remained in self-help and did not receive additional treatment, which suggests the presence of potential barriers aside from treatment intensity were interfering with weight loss success. However, the participants who remained in self-help maintained a statistically significant 6.9%

greater weight loss from baseline to the 6-month post-treatment follow-up than the stepped-up participants.

A few other stepped-care BWLT studies produced similar findings. Carels and colleagues (2012) found that weight loss success could be predicted by early weight loss during the self-help phase and that increasing the intensity of a weight loss treatment does not always improve outcomes (Carels et al., 2008). Similarly, in a somewhat more complicated three-step design (self-help to group to individual counseling), Carels et al. (2012) found that nearly all self-help participants stepped up to group counseling following the initial self-help phase needed to be stepped up again to simultaneous individual counseling after a second failure to reach the study's pre-determined weight loss goals. Again, these findings indicate that there may be other variables beyond treatment intensity affecting an individual's success in a stepped-care BWLT that need to be identified and explored.

With one exception, most studies examining the effectiveness of a stepped-care model for weight loss interventions have been performed with a small number of participants, of short study duration, and have sometimes lacked a standard BWLT control group for comparison. Jakicic and colleagues (2012) conducted a large stepped care study ($N = 363$) in which the participants ($25 < \text{BMI} < 40 \text{ kg/m}^2$) were randomized to either the standard behavioral weight loss intervention (SBWI) or the stepped-care weight loss intervention (STEP). Both programs prescribed weight loss participants with a low-calorie (amount based on starting weight), low-fat diet, an increase in physical activity, and knowledge regarding weight loss behavioral change and maintenance. The SBWI group participated in a weekly group for months 1-6 that decreased in contact frequency in following months; this tapering of program contact is typical of a standard BWLT. In contrast, the STEP group began with participation in a monthly group and

only received increased contact if they did not lose 5% of their bodyweight by month 3, 7% bodyweight by month 6, or 10% bodyweight by month 9 and beyond. Although the SBWI group had a 1.2% greater weight loss at month 18, this difference was not statistically significant; however, the group x time interaction effect ($p = .03$) was significant. Notably, SBWI group also costed nearly twice as much for the provider and participant combined compared to the STEP group. Therefore, stepped-care BWLT appears to be more cost effective intervention than standard BWLT. Resource efficiency is an important consideration for combatting an ever-growing obesity problem.

Weight Loss Factors

Even in the most successful weight loss programs there are participants who drop out and do not achieve significant weight loss. However, very few studies have assessed perceived barriers to successful weight loss.

Barriers

A lack of time, motivation, and enjoyment are often cited as barriers to physical activity (Ciao, Latner, & Durso, 2012; Leone & Ward, 2013). A 24-month standard group-based BWLT found that greater treatment intensity was correlated with fewer perceived barriers to healthy eating; the reduction of group meeting frequency over time in the program correlated with increased report of barriers and greater caloric and fat intake (Wang, Zheng, & Burke, 2015). Further, greater perceived barriers to healthy eating (i.e., emotions, daily mechanics, and social support) were associated with poorer weight loss outcomes, suggesting that greater treatment intensity helped to remove barriers and, therefore, facilitated weight loss success. While the explanation for this relationship is not entirely clear, it is possible that the group meetings provided accountability and social support that served to reduce barriers. Another possible

explanation is that participant motivation to lose weight decreased over time, thus allowing more barriers to emerge. Hence, identifying and resolving perceived barriers early on in a weight loss intervention may result in improved weight loss outcomes.

In another study with more in-depth semi-structured focus groups, African American women ($N = 28$) with a BMI ≥ 25 living in impoverished areas were asked to identify common barriers to exercise and healthy eating (Baruth, Sharpe, Parra-Medina, & Wilcox, 2014). Lack of motivation, energy, or time, fear of failure, and fear of receiving body-shaming comments from others were among some of the more commonly reported barriers to exercise. Lack of knowledge surrounding healthy eating, lack of social support from friends and family, high prices of healthy food, the role of food in socializing, and eating when not hungry due to stress or depression were among some of the more common reported barriers to healthy eating. While this study is limited by a small and homogeneous sample, these barriers are consistent with other studies (Leone & Ward, 2013; Ciao, Latner, & Durso, 2012).

Depression

Another potential barrier to weight loss identified in the research literature is depression. Many studies have investigated the relationship between obesity and depression and provided evidence that there is a positive correlation between obesity (BMI) and depression (Rosmond, Lapidus, Marin, & Bjorntorp, 1996; Fabricatore & Wadden, 2004; Johnston, Johnson, McLeod, & Johnston, 2004; Blaine, 2008; Wiltink et al., 2013; Opel et al., 2015). Studies have shown a relationship between depression and weight regain (i.e., failure to maintain weight loss; McGuire, Wing, Klem, Lang, & Hill, 1999; Brantley et al., 2014; Wing & Phelan, 2005). However, there are only a few studies that looked at whether symptoms of depression interfere with weight loss itself (Trief, Cibula, Delahanty, & Weinstock, 2014).

Clark, Niaura, King, and Pera (1996) found that participants with more symptoms of depression, as measured by the Beck Depression Inventory (BDI), attended fewer weight loss treatment sessions and were more likely to drop out of the program than individuals with fewer symptoms of depression. More recently, researchers examined the influence of depression on weight loss in the SHINE (Support, Health Information, Nutrition, and Exercise) program, which translated the DPP to be delivered through individual and conference phone calls (Trief et al., 2014). Individuals who reported higher levels of depression, as measured by the CES-D, lost and maintained significantly less weight than the individuals who reported lower levels of depression at baseline, 6-months, 1 year, and 2 years. Not surprisingly, the researchers also found that the participants reporting higher levels of depression demonstrated lower adherence to the program than the other participants.

It is important to note that research suggests that the relationship between depression and obesity is likely to be reciprocal (Markowitz, Friedman, & Arent, 2008). For example, levels of psychological distress are lowered following weight loss (Dalle Grave, Calugi, Petroni, Di Domizio, & Marchesini, 2010; Lasikiewicz, Myrissa, Hoyland, & Lawton, 2014). One aim of the current study is to examine whether depression serves as a barrier to achieving successful weight loss outcomes.

Social Support

Another potentially important component of successful weight loss is the presence of social support. For example, a qualitative study of women, who had completed an 18-week weight loss program centered on a restrictive diet and nutrition education, reported that the most important keys to overall weight loss and maintenance success were external accountability and social support (Metzgar, Preston, Miller, & Nickols-Richardson, 2015). In another qualitative

study, Whale, Gillison, and Smith (2014) supported the notion that a lack of social support creates a barrier to weight loss; for example, participants reported receiving negativity and dissuasion from friends and family while following a weight loss diet, especially relating to eating in a social context.

In another study, Gorin, Powers, Koestner, Wing, & Raynor (2014) found that receiving autonomous support from a household partner was more helpful and conducive to successful weight loss than receiving directive, or controlled, support. This distinction, derived from Self-Determination Theory, lies in the difference between supporting the individual's own choices (autonomous) and giving them advice or pressure to make certain choices (controlled; Deci & Ryan, 2000). An example of autonomous support is supporting your spouse's desire to go to the gym by watching the kids for an hour; an example of controlled support is suggesting your spouse should eat an apple instead of a cookie for dessert. Both examples demonstrate supporting your spouse's weight loss efforts, but the former example of support allows your spouse to act on a decision they made while the latter example of support urges your spouse to act in a way to avoid guilt from an external pressure.

Romantic partners may facilitate or interfere with one's weight loss goals, depending on factors such as providing support for or discouraging their healthy diet (Theiss, Carpenter, & Leustek, 2016). An older meta-analysis is consistent with these findings, concluding that weight loss programs involving both members of a couple result in better weight loss success than traditional BWLT that enroll participants without their partner (Black, Gleser, & Kooyers, 1990). Further, in another study, 25.9% more women who received frequent social support from friends and family during a 6-month group-based BWLT lost at least 5.0% of their initial bodyweight than women who reported receiving no support from family members (Kiernan et al., 2012).

Wing and Jeffery (1999) examined the importance of social support for weight loss and weight maintenance in a randomized controlled standard behavioral treatment (SBT). They introduced an experimental social support condition through activities to create unity within a group of four participants and financial incentives to compete with other groups relating to 6-month weight maintenance goals. Participants were assigned to one of four conditions: 1) SBT (recruited alone), 2) SBT plus social support intervention (recruited alone), 3) SBT (recruited with friends), 4) SBT plus social support intervention (recruited with friends). Social support was related to attrition, with SBT recruited alone (condition 1) having the highest rate of 21% and SBT plus social support intervention recruited with friends (condition 4) having the lowest rate of 2% over the 4-month treatment phase. Participants who entered the study with friends lost an average of 2.1 kg and 2.9 kg more than the participants who participated in the intervention alone over the 4 months of the treatment phase and 10 months of the treatment and maintenance phases combined, respectively. Receiving more active support where friends and families participated in exercise and behavior change resulted in better weight maintenance than did solely receiving verbal support and encouragement (Karfopoulou, Anastasiou, Avgeraki, Kosmidis, & Yannakoulia, 2016).

Current Study

The current research study collected data on participants enrolled in a stepped-care behavioral weight loss intervention program. All participants were provided with a version of the Diabetes Prevention Program (2002) modified for self-help and a Fitbit pedometer to track physical activity. If participants did not lose 2.5% of their baseline weight by the 2-month assessment, then they were stepped up to Slimfast meal replacement shakes. A previous stepped-care weight loss intervention found success with stepping up participants who have not

met the criterion of losing 2.5% of their bodyweight one-third of the way into the study (Carels et al., 2009). If participants did not lose 5.0% of their baseline weight by the 4-month assessment, they were stepped up to either meal replacement or individual counseling (if previously stepped to meal replacement) for the final two months of the program.

Identifying and removing barriers to weight loss early in treatment is likely to lead to long-term weight loss success (Mauro, Taylor, Wharton, & Sharma, 2008). Further, solving barriers may reduce unproductive use of participant resources and increase the individual's likelihood to continue with a weight loss program. This study aims to contribute to the literature on the relationship between perceived barriers, attrition, and poor weight loss outcomes. Overall, the goal of the current research study is to improve future behavioral weight loss interventions by better identifying potential barriers to weight loss at different time intervals of the treatment. While several studies have examined the perceived barriers to weight loss, no studies have examined the perceived barriers to weight loss in a self-help stepped-care model of BWLT. Further, it is novel to examine barriers reported prior to and during a weight loss program and whether these barriers are associated with being stepped-up, dropping out, or weight loss outcomes.

The current research objectives are as follows: (1) to identify the perceived barriers to weight loss in a stepped-care weight loss program, (2) to examine how perceived barriers, depression symptoms, and social support are related to treatment outcomes (i.e., % weight lost), stepped status, and attrition, and (3) to assess the targeted variables at four separate time points in treatment (baseline, month 2, month 4, and month 6/post-treatment). Longitudinal assessment of these variables over the 6-month duration of the intervention may reveal if participants can

overcome certain barriers or if barriers change over the course of treatment. My hypotheses are as follows:

Hypothesis 1. Participants who completed the program will report fewer symptoms of depression, greater frequency and helpfulness of social support, and fewer barriers to weight loss at the four time points (baseline, month 2, month 4, and month 6) than those who dropped out of the study.

Hypothesis 2. Participants who received more stepped-care will report greater symptoms of depression, less frequency and helpfulness of social support, and more barriers to weight loss at the four time points (baseline, month 2, month 4, and month 6) than participants who received less intense treatment.

Hypothesis 3. Participants with fewer symptoms of depression, greater frequency and helpfulness of social support, and fewer barriers to weight loss at the four time points (baseline, month 2, month 4, and month 6) will lose a greater percentage of their bodyweight than other participants.

Hypothesis 4. As an exploratory hypothesis, participants will experience different types of barriers to weight loss (i.e., various barriers related to diet and exercise) at different time points (baseline, month 2, month 4, and month 6). For example, as time goes on throughout the study there may be more reported internal physical activity barriers (i.e., motivation to exercise).

Methods

Procedures

Participants. Enrollment included 53 individuals who were recruited from a large university and community in the Southeast through an email listserv at the university and a local newspaper ad for the weight loss program. Interested individuals called or emailed to receive details about the study and respond to screening questions. Individuals were eligible for the study if they were at least 18 years of age, had a BMI ≥ 27 , were not currently or planning to become pregnant in the upcoming year, did not have a medical condition preventing physical activity, and did not have bariatric surgery. If deemed eligible, individuals were scheduled for an orientation session. Participants were compensated for their time with a \$20 gift card for completing the baseline assessment and another \$20 gift card for completing the post-treatment assessment. Participants were also included in a 2-week ecological momentary assessment (EMA) study related to experiences of weight stigma prior to the current weight loss intervention. The EMA study is not included in the current investigation.

Orientation and Baseline Assessment. All participants who participated in the EMA study were consented for both the EMA and weight loss treatment during a January 2016 orientation; participants of the weight loss study who did not participate in the EMA portion were consented during the February 2016 orientation. During the orientation sessions, participants received further details and expectations for participation in the weight loss phase of the study, including a more detailed explanation of the stepped-care procedure. There was ample opportunity for participants to ask questions.

Participants were provided with the first 8 weeks of the DPP manual, which was modified to be used for self-help (Diabetes Prevention Program Research Group, 2002). They

received a new Fitbit Zip® device to use for the duration of the study. Study staff provided thorough instructions on how to use the Fitbit and the accompanying website and smartphone application and ensured everyone felt comfortable with their new technology prior to leaving the orientation session. One participant who did not own a smartphone borrowed an iPad from our lab for the study's duration. Participants' height and weight were measured privately, and their BMIs were calculated to confirm eligibility. Finally, participants completed a baseline assessment consisting of an online battery of questionnaires on SurveyMonkey, a secure website commonly used to deliver surveys and collect data. The survey required approximately 45 minutes to complete and served to assess their demographics, past barriers to weight loss, symptoms of depression, and perceived frequency and helpfulness of social support. Other measures not included in this study were assessed at baseline.

Intervention. The content of the 6-month weight loss intervention consisted of a self-help modified version of the DPP manual. Additionally, participants monitored their physical activity, nutrition, and weight using the Fitbit Zip device and Fitbit phone application or website. Participant treatment intensity need was evaluated every two months throughout the study (at months 2 and 4) using pre-determined weight loss goals calculated at baseline. Using their baseline weight measurement, participants were given the goal to lose 2.5% of their bodyweight by month 2 and 5.0% of their bodyweight by month 4 to not be stepped-up to a more intense treatment. The 6-month goal was to lose 7.5% of their baseline bodyweight, although no step-up occurred as it was the end of treatment.

Step One. All participants began treatment by reading one chapter of the DPP manual per week. They received the first 8 chapters in a binder that they were allowed to keep after the end of treatment. Simultaneously, they were asked to wear and sync their Fitbit Zip daily and record

what they consumed in the nutrition log. They also had the option to monitor their water intake and record activities not captured by the Zip, such as swimming or stationary weight training. Detailed instructions were provided to all participants verbally during orientation and in the form of a paper handout. If participants needed assistance with their technology throughout the intervention, they contacted the study staff via email and Fitbit customer support as needed.

Step Two. At month 2 participants attended an assessment where they were weighed, evaluated for stepped-up care, and received the next 8 chapters (8 weeks) of the DPP manual. Participants who did not lose 2.5% of their baseline bodyweight by month two were provided with two cans of Slimfast powder. Participants were asked to replace one meal or snack per day with 1 scoop (1/4 cup; 110 calories) of the powder mixed with water or low-fat milk. All participants, regardless of goal attainment, were instructed to continue to read and complete the activities in the corresponding DPP chapter each week, to continue to wear and monitor their Zips, and to complete the 2-month questionnaire at home. The questionnaire was delivered to their email via a SurveyMonkey link one week prior to the week of their 2-month visit. The survey was relatively brief and served to assess barriers to weight loss, symptoms of depression, and perceived social support during the first two month of the intervention.

Step Three. At month 4 participants attended an assessment where they were weighed, evaluated for stepped-up care, and received the next 8 chapters (8 weeks) of the DPP manual. Participants who lost 5.0% of their baseline bodyweight by month 4 and were not previously stepped up to meal replacement shakes were not given additional treatment; they continued to follow the DPP self-help manual and use their Fitbit device. Participants who lost 5.0% of their baseline bodyweight and were previously stepped-up were instructed to continue using the meal replacement shakes. Participants who did not lose 5.0% of their baseline bodyweight by month 4

and were not stepped-up at month 2 received the Slimfast meal replacement. Participants who did not lose 5.0% of their baseline bodyweight by month 4 and were previously stepped up to meal replacement were instructed to continue meal replacement. Additionally, they were provided with individual counseling for the remaining 8 weeks of the intervention. The individual counseling was designed to provide one 50 minute in-person sessions and three 20-minute phone sessions each month. The study interventionists were doctoral students trained to use a modified version of the problem-solving therapy protocol (Nezu, Nezu, & D’Zurilla, 2013). All participants, regardless of goal attainment, were instructed to continue to read and complete the activities in the corresponding DPP chapter each week, to continue to wear and monitor their Zips, and to complete the 4-month questionnaire at home. The questionnaire was delivered to their email via a SurveyMonkey link one week prior to the week of their 4-month visit. Again, the survey was relatively brief and served to assess barriers to weight loss, symptoms of depression, and perceived social support during months 3 and 4 of the intervention.

Post-Treatment. All participants attended a final assessment visit at month 6 of the intervention. They were weighed, returned the Fitbit, and received their second compensation of \$20. Additionally, they completed a post-treatment battery of questionnaires during their scheduled visit to assess their barriers to weight loss, symptoms of depression, and perceived social support during the final two months of the intervention.

Measures

Demographics. Participants completed a demographic survey to assess for age, gender, race, highest education achieved, and socioeconomic status. Two questions regarding weight loss history were also included.

Height and Weight. Height and weight were measured at baseline, month 2, month 4, and post-treatment (month 6). Height was measured in inches using a stadiometer height rod (Seca #2131821009). Weight was measured in pounds with a digital scale (Tanita, WB-110A). These height and weight measurements were used to calculate BMI, determine eligibility for the study, and monitor changes in participants' weight loss progress.

Barriers to Weight Loss. Participants completed the Barriers to Weight Loss measure at baseline and months 2, 4, and 6. This measure was adapted from the barriers measure created by Sharifi, Mahdavi, and Ebrahimi-Mameghani (2013), which reported good internal reliability ($\alpha = .80$). All items in the Barriers measure used in the current study were modified from Sharifi et al.'s (2013) study to enhance relevancy to the current study's aims. For example, the instructions were changed accordingly, i.e., "in the past" was used at baseline referring to previous weight loss attempts and "in the past two months" was used at months 2, 4, and 6. The items mainly consisted of statements related to diet and physical activity barriers. Examples of the items included, "It was hard to follow a weight-loss diet when my family did not support me." and "I was often too tired or did not have enough energy to work out." Possible responses to each item were: 1 = not true for me, 2 = a little bit true for me, 3 = somewhat true, 4 = pretty true for me, 5 = very true for me. The barriers measure also demonstrated good internal reliability in the current study ($\alpha = .86$).

Center for Epidemiologic Studies Depression Scale (CES-D). Participants completed the CES-D, which consists of 20 statements about how the responder felt or behaved in the past week, during the baseline and post-treatment assessments (months 0 and 6, respectively). Examples of items include, "I was bothered by things that usually don't bother me" and "I felt hopeful about the future." Responses may range from "rarely or none of the time (less than 1

day)” to “all of the time (5-7 days).” Severity of depression symptoms is determined by the frequency of the endorsed symptoms. The CES-D is considered a reliable ($\alpha = .85$) and valid measure for use in the general population (Radloff, 1977). The measure also demonstrated good internal reliability in the current study ($\alpha = .89$).

Center for Epidemiologic Studies Short Depression Scale (CES-D 10). The CES-D 10 is the shortened version of the CES-D, consisting of half of the items with identical response options (Andersen, Malmgren, Carter, & Patrick, 1994). This shortened measure was administered at months 2 and 4 instead of the full CES-D to reduce participant burden, as they were only receiving compensation for their time completing the baseline and 6-month/post-treatment assessments. The participants completed this measure to assess for symptoms of depression. This shortened measure has good reliability and validity ($\alpha = 0.89$; Björgvinsson, Kertz, Bigda-Peyton, McCoy, & Aderka, 2013). The measure also demonstrated good internal reliability in the current study ($\alpha = .83$).

Weight Management Support Inventory (WMSI). The WMSI consists of 26 items to assess for frequency of received social support (from “never” to “daily”) and how helpful each behavior was (from “not helpful/does not apply” to “extremely helpful”) over the past four weeks. Examples of items include, “Other members of my household avoid buying junk food or having it in the house” and “Others tell me ways to change my exercise routine so I won't get bored.” The measure consists of four subscales: emotional (e.g., “Others listen to my concerns about the difficulty of dieting.”), instrumental (e.g., “Others go walking or jogging with me for exercise.”), informational (e.g., “Others tell me about the calorie or fat content of foods.”), and appraisal (e.g., “Others compliment me when they notice I've lost weight.”). Participants completed this measure at baseline, and months 2, 4, and 6. The WMSI is a valid (confirmatory

factor analysis Tucker-Lewis index $> .90$) and reliable ($\alpha = .90$) measure (Rieder & Ruderman, 2007). The measure demonstrated good internal reliability in the current study ($\alpha = .86$).

Data Analysis Plan

Hypothesis 1. Participants who completed the program will report fewer symptoms of depression, greater frequency and helpfulness of social support, and fewer barriers to weight loss than those who dropped out of the study. Differences between participants who completed the intervention and dropped out will be examined through t-tests at three time points (baseline, month 2, and month 4). However, no analyses could be conducted for the six-month time point since none of the participants who had dropped out of the study returned for the post-assessment visit to complete the questionnaires in person.

Hypothesis 2. The more stepped-care received by a participant, the greater symptoms of depression, less frequency and helpfulness of social support, and more barriers to weight loss they will experience. Differences between participants who are not stepped, stepped once, and stepped twice, on the constructs of depression, social support, demographics, and barriers to weight loss will be examined through ANOVA tests at the four time points (baseline, month 2, month 4, and month 6).

Hypothesis 3. Greater percent of bodyweight lost from baseline to post-treatment (6 months) will be associated with fewer symptoms of depression, greater frequency and helpfulness of social support, and fewer barriers to weight loss. Correlational analyses will be used to assess for this relationship at the four time points (baseline, month 2, month 4, and month 6).

Hypothesis 4. Different types of barriers to weight loss (i.e., various barriers related to diet and exercise) will be reported at different time points (baseline, month 2, month 4, and

month 6). These post hoc differences will be explored through ANOVA.

Results

At the end of the six-month weight loss program, 38 out of 53 participants completed the entire study. Of the 38 who remained in the study, 15 participants remained in self-help (non-stepped), 8 participants were stepped to meal replacements only (once-stepped), and 15 additional participants were stepped to both meal replacements and counseling (twice-stepped). Of the 15 participants who dropped out of the study, 12 participants dropped prior to month two (first assessment of stepped care need), 2 participants dropped after being stepped once, and 1 participant dropped after being stepped twice. The average weight loss for the overall sample was 5.1% ($SD = 4.4\%$); non-stepped participants lost an average of 8.7% ($SD = 3.6\%$), once-stepped participants lost 6.0% ($SD = 2.6\%$), and twice-stepped participants lost 1.0% ($SD = 2.4\%$) of baseline bodyweight (Carels, Selensky, Rossi, Solar, & Hlavka, 2017).

There were no sex differences for barriers, depression, or the majority of social support measures at baseline. The only significant difference was that females ($M = .82, SD = .79$) reported receiving significantly greater appraisal support frequency than males ($M = .38, SD = .25$), $p = .002$. There were no significant differences on any of the variables for ethnicity. A few variables were related to income level, including a higher depression score related to lower income, $r = -.428, p = .013$. A few types of social support increased with income: the frequency of instrumental support ($p = .001, r = .616$), the helpfulness of instrumental support ($p = .022, r = .448$), and the frequency of informational support ($p = .008, r = .497$). Older age was related to lower depression ($r = -.291, p = .040$), fewer adverse effects of diet barriers ($r = -.520, p = .000$), fewer cost of diet barriers ($r = -.307, p = .045$), fewer external physical activity barriers ($r = -.370, p = .015$), and fewer total barriers ($r = -.333, p = .029$).

Hypothesis 1

A series of independent samples t-tests were conducted to compare the depression, social support, and barriers scores at three of the four time points (baseline, month two, and month four) for participants who completed and dropped out of the weight loss program (see Table 1). At baseline, there was a significant difference in social pressure barrier scores for participants who completed and dropped out ($t(30) = -2.25, p = .032$). Because Levene's Test for Equality of Variances was significant, $p = .024$, equal variances were not assumed and the Welch-Satterthwaite test was used. The social pressure barriers were significantly lower in the completed group than the dropped group (mean difference = $-.70$, 95% CI: -1.34 to $-.06$). All other differences at baseline were not significant.

At month two, there was a significant difference in the helpfulness of informational support scores for participants who completed and dropped out, $t(46) = -2.38, p = .022$. The completed group found informational support to be significantly less helpful than the dropped group (mean difference = $-.85$, 95% CI: -1.58 to $-.13$). Similarly, the completed group found appraisal support less helpful than the dropped group, $t(45) = -2.04, p = .047$ (mean difference = $-.82$, 95% CI: -1.63 to $-.01$). There was also a significant difference between completed and dropped groups for social pressure barriers scores at month two, $t(48) = -2.05, p = .046$. The completed group experienced significantly fewer social pressure barriers than the dropped group (mean difference = $-.47$, 95% CI: $-.93$ to $-.01$). There was a significant difference at month two for food craving barriers between completed and dropped, $t(48) = -3.25, p = .002$, with significantly fewer food craving barriers in the completed than the dropped group (mean difference = $-.57$, 95% CI: $-.92$ to $-.22$). Finally, there was a significant difference in the total barriers scores at month two for completed and dropped, $t(48) = -2.02, p = .049$. The total barriers were significantly lower in the completed group than the dropped group (mean

difference = -8.66, 95% *CI*: -17.26 to -.06). All other differences at month two were not found to be statistically significant.

At month four, there was a significant difference in the depression scores for completed and dropped, $t(17) = 2.97, p = .008$. Levene's Test for Equality of Variances was significant, $p = .043$, so equal variances were not assumed and the Welch-Satterthwaite test was used. The depression scores were significantly higher in the completed group than the dropped group (mean difference = 3.66, 95% *CI*: 1.07 to 6.25). All other differences at month four were not significant between participants who completed or dropped from the program. Differences were not assessed at month 6 as participants in the dropped group did not return for the post-assessment and, therefore, could not complete measures of depression, support, and barriers.

Hypothesis 2

A series of one-way between-group analysis of variance (ANOVA) tests were conducted to compare differences between stepped statuses (non-stepped, once-stepped, or twice-stepped) on depression, social support, and barriers scores at the four time points (see Table 2). There was a statistically significant difference between the stepped groups measured at baseline for situational barriers experienced in past weight loss efforts, $F(2) = 4.63, p = .022$. The Welch-Satterthwaite test was used for this analysis because equal variances were not assumed (Levene's Test for Equality of Variances, $p = .020$). Post-hoc comparisons using the Tukey HSD test indicated that non-stepped participants experienced significantly fewer situational barriers than once-stepped participants, $p = .024$. Twice-stepped participants did not differ significantly from either group on previous situational barriers.

There were differences between the stepped groups for external physical activity barriers in past weight loss efforts, $F(2) = 3.78, p = .034$. Non-stepped participants experienced

significantly fewer external physical activity barriers than once-stepped participants, $p = .029$. Twice-stepped participants did not differ from the other groups on this barrier at baseline. Significant differences were not found between stepped groups for other barriers at baseline.

At month two, significant differences were found between stepped groups on scores for the first two months of the weight loss program. There was a difference found between groups on the stress and depression barriers score using the Welch Robust Test of Equality of Means (Levene's Test for Equality of Variances, $p = .023$), $F(2) = 5.72$, $p = .009$. Post-hoc Tukey HSD test indicated that the stress and depression barriers score for non-stepped participants was significantly lower than twice-stepped participants, $p = .033$. Food craving barrier scores differed between groups at month two, $F(2) = 3.79$, $p = .032$. Post-hoc tests showed that non-stepped participants experienced significantly fewer food craving barriers in the first two months of the program than once-stepped participants, $p = .024$. Stepped groups differed on total barriers scores, $F(2) = 3.29$, $p = .048$, with non-stepped participants experiencing significantly fewer barriers overall than once-stepped participants, $p = .043$.

There were no differences between groups at month four (depression, social support, and barriers reported for months 3 and 4 of the program). At month six, there was a difference between groups on the frequency of emotional social support, $F(2) = 3.48$, $p = .041$. Post-hoc tests indicated that twice-stepped participants experienced a significantly higher frequency of emotional social support than non-stepped participants during the last two months of the weight loss program, $p = .032$.

Additionally, participants who received any stepped care were compared to participants who received no additional assistance (see Table 3). Participants who received any stepped treatment experienced significantly more food craving barriers in the first two months than non-

stepped participants ($t(39) = -2.26, p = .029$). Stepped participants ($M = 3.73, SD = .97$) were marginally more likely to report past situational barriers relative to non-stepped participants ($M = 2.82, SD = 1.39, p = .053$) with this finding being driven more by once-stepped than twice-stepped participants. Stepped participants ($M = 2.74, SD = .87$) failed to meet conventional standards of significance greater than non-stepped participants on past external physical activity barriers ($p = .066$). Stepped participants ($M = 2.69, SD = 1.08, p = .005$) reported greater stress and depression barriers than non-stepped participants during the first two months.

Hypothesis 3

The relationships between total percentage of bodyweight lost from baseline to 6 months and depression, social support, and barriers scores were explored at the four time points using Pearson correlation coefficient. However, only a few relationships showed significant correlations. There was a significant relationship showing greater percentage of bodyweight lost relating to fewer cost of diet barriers at baseline ($r = -.378, p = .036$) and at month two ($r = -.413, p = .021$). There were no significant relationships at month four. At month six, a greater percentage of bodyweight lost was significantly associated with a lower frequency of received informational support ($r = -.402, p = .025$).

Hypothesis 4

A one-way repeated measures ANOVA was conducted to compare scores on the different barriers factors and total barriers at baseline (previously experienced barriers to weight loss), month two, month four, and month six (see Table 4). Barriers reported did not differ between months two, four, and six. Significant differences were found between all barriers experienced in previous weight loss efforts and barriers experienced throughout the current weight loss program (months two, four, and six).

On situational barriers, previous weight loss barriers were significantly greater than current weight loss barriers at months two and six, Wilks' Lambda = .70, $F(3) = 3.89$, $p = .020$. There were significantly more stress and depression barriers reported for prior weight loss efforts than in the current weight loss study at month two, Wilks' Lambda = .64, $F(3) = 5.17$, $p = .006$. Social pressure barriers were significantly greater in previous weight loss efforts than in the current program at months two, four, and six, Wilks' Lambda = .66, $F(3) = 4.74$, $p = .009$. There were fewer adverse effects of diet barriers reported in the current study at months two, four, and six than in prior weight loss efforts, Wilks' Lambda = .34, $F(3) = 17.74$, $p = .000$. On food craving barriers, previous weight loss barriers were significantly greater than current weight loss barriers at month two, Wilks' Lambda = .69, $F(3) = 4.04$, $p = .017$. Cost of diet barriers were greater in previous weight loss efforts than in current weight loss efforts at month two, Wilks' Lambda = .72, $F(3) = 3.58$, $p = .027$. Participants experienced fewer external physical activity barriers at months four and six in the current study than in their prior weight loss attempts, Wilks' Lambda = .57, $F(3) = 6.86$, $p = .001$. Participants also experienced fewer internal physical activity barriers at months two, four, and six than they did previously, Wilks' Lambda = .56, $F(3) = 7.22$, $p = .001$. Finally, the total barriers were greater for previous weight loss efforts than in the current study at months two, four, and six, Wilks' Lambda = .45, $F(3) = 10.49$, $p = .000$.

A one-way repeated measures ANOVA was conducted to compare scores on depression across the four time points (see Table 4). Since the CES-D was administered at baseline and month 6 and the CES-D 10 was administered at months two and four to reduce participant burden, the 10 items from the CES-D 10 were used to calculate depression scores at baseline and month 6. There were no significant differences found on depression scores across the four time

points. Another series of one-way repeated measures ANOVA compared differences in social support frequency and helpfulness across the four time points, and a couple of significant changes were found over time (see Table 4). The helpfulness of emotional support significantly increased over time throughout the study from reports at month two to month six, $F(3) = 4.77, p = .011$. The helpfulness of informational support also increased over the course of the weight loss program as reported from month two to month six, $F(3) = 3.06, p = .05$.

Discussion

The primary aim of this investigation was to identify barriers to weight loss in a stepped-care intervention. A previous paper reported on weight loss outcomes and the relationships between weight loss outcomes, self-monitoring, and health literacy (Carels et al., 2017). The current paper conducted with the same sample examined whether depressive symptoms, social support, and barriers to weight loss were related to attrition, stepped status, and weight loss outcomes.

The first hypothesis of the current study explored the differences between participants who completed and dropped out of the weight loss program on depressive symptoms, social support, and barriers to weight loss. It was predicted that the participants who completed the program would report fewer depressive symptoms, greater frequency and helpfulness of social support, and fewer barriers to weight loss throughout the study. Participants who dropped out of the program reported more barriers overall during the initial two months of the study than participants who completed the program. Specifically, participants who dropped out reported more social pressure barriers, more food craving barriers, greater helpfulness of instrumental support, and greater helpfulness of appraisal support.

The second hypothesis predicted that participants who received more stepped care would report more depressive symptoms, more barriers, and less social support during the study than participants who did not need more intense treatment. Once-stepped participants reported more situational barriers and external physical activity barriers than non-stepped participants in previous weight loss efforts. Non-stepped participants reported fewer stress and depression barriers than twice-stepped participants and fewer food craving barriers than once-stepped

participants in the first two months of the program. Twice-stepped participants reported greater emotional support frequency than non-stepped participants in the last two months of the study.

The third hypothesis speculated that participants who lost a greater percentage of bodyweight over the six months would report fewer depressive symptoms, fewer barriers, and more social support. However, there were few variables related to weight loss. The fourth hypothesis was interested in exploring any changes to these variables over time, such as the increase or reduction of certain barriers in response to the weight loss treatment. There were only significant barrier differences between baseline reports (previous weight loss efforts) and reports during the current study; barrier variables did not vary throughout the current program. Taken together, these findings will be discussed in greater detail below in separate sections addressing barriers, depression, and support, respectively.

Barriers

While there are many barriers to weight loss, one common barrier for individuals trying to lose weight is to feel pressured into eating unhealthy food items in social settings by friends and family members. For example, in one study, women in commercial weight loss programs reported that negative reactions from their friends regarding their weight loss efforts and experiencing pressure to eat sugary foods were significant barriers to motivation and weight loss success (Whale et al., 2014). While the ultimate motives for these comments are unclear, participants speculated that the lack of support was related to others' fear of them changing as a result of weight loss (Whale et al., 2014). It is, perhaps, unsurprising that participants who dropped out of the current study reported significantly more social pressure barriers in past weight loss efforts and during the first two months of the program than participants who completed the study. However, given that this barrier was not evident at months four or six

suggests that it may be a potentially important barrier early in treatment while new eating patterns are being established. These findings are consistent with recommendations by other researchers who suggest that communication training may help to buffer the effects of others' negative comments among individuals who are attempting to lose weight (Liebl, Barnason, & Hudson, 2016).

Another important difference between completers and drop-outs were food craving barriers reported during the first two months of the program. Food cravings have been associated with increased caloric consumption in prior research (Buscemi, Rybak, Berlin, Murphy, & Raynor, 2017). For example, in an 18-month weight loss trial it was found that food cravings were related to a higher caloric intake and slower weight loss progress (Buscemi et al., 2017). While not examined in Buscemi and colleagues (2017), it is plausible that significantly slower weight loss progress could lead to increased feelings of frustration and discouragement that could ultimately lead to higher attrition. The current findings support this; greater report of food craving barriers were related to dropping out of the weight loss program and increased stepped-care need. At month two, completers lost 3.1% and drop-outs lost 1.7% of baseline body weight. While the difference in weight loss percentages between the two groups was not statistically significant ($p = .16$) it was in the expected direction. People with more food cravings lost weight at a slower rate, and the likely frustration and discouragement of slower weight loss contributed to dropping out of the program.

Food craving barriers during the first two months of the program were also related to stepped-status. Analyses indicated that participants who received any step experienced significantly more food craving barriers in the first two months than non-stepped participants. Interestingly, participants who were stepped once reported greater food cravings than non-

stepped participants. While twice-stepped participants alone did not significantly differ from non-stepped participants on food craving barriers, it was in the expected direction. Nevertheless, early in treatment, both stepped groups reported additional food cravings relative to people who did not need additional assistance. In the current investigation, the first step of more intensive care received by all stepped participants was meal replacements, which aimed to replace a “problematic” meal and aid in the reduction of caloric intake. The previously mentioned study by Buscemi and colleagues (2017) further demonstrated that the combined reduction of caloric intake and reduction of the craved foods resulted in fewer food cravings (Anton et al., 2012; Martin, O'Neil, & Pawlow, 2006; Martin et al., 2011). Given that both once-stepped and twice-stepped participants received meal replacements, it is possible that receipt of meal replacements by the stepped participants may have reduced food craving barriers, particularly if the problematic meal that they chose to replace included craved foods.

It is perhaps unsurprising to find that greater attrition is related to greater total barriers as well. However, post-hoc analyses were conducted to determine whether there was still a significant difference between drop-outs and completers on total barriers when social pressure barrier and food craving barrier factors were excluded ($t(48) = -1.89, p = .065$). Independent samples t-tests determined that social pressure and food craving barriers were driving the relationship between attrition and total barriers. Together, these findings suggest that the beginning of a weight loss program may be a particularly critical period for certain barriers to derail weight loss efforts. Early in an individual's attempts to make weight loss behavior changes, the contradicting pressure from friends and family members and the cravings of certain foods could undermine an individual's ability to persevere through the initial frustrations and ultimately lead to attrition. Teaching individuals how to overcome initial social pressure and

food cravings early in treatment may be important skills taught early in a weight loss program to reduce attrition and improve weight loss success.

When participants reported on barriers they experienced in previous weight loss efforts, situational barriers differed by stepped status. Situational barriers reflect difficulty making healthy food choices when eating out, at a social event, and when travelling. Non-stepped participants reported significantly fewer past situational barriers than once-stepped participants. Interestingly, combined stepped participants were marginally more likely to report past situational barriers relative to non-stepped participants, with this finding being driven more by once-stepped than twice stepped participants. Participants also reported that external physical activity barriers (i.e., lack of time, accountability, gym access, safe neighborhood; vs. internal barriers of pain, too tired, weight, lack of motivation) were commonly experienced in previous weight loss efforts. These barriers differed by step status. Once-stepped participants reported significantly greater external physical activity barriers in previous weight loss efforts than non-stepped participants, and twice-stepped participants were in the expected direction. However, when twice-stepped participants were combined with once-stepped participants they failed to meet conventional standards of significance when compared with non-stepped participants on past external physical activity barriers ($p = .066$). Therefore, generally speaking, non-stepped participants reported fewer past situational and external physical activity barriers relative to individuals who required additional assistance. Past situational barriers and past external physical activity barriers might identify people who will experience difficulties during a weight loss attempt. Although, it is unclear why participants only reported these barriers in previous weight loss efforts and not at months 2, 4, and 6 of the current weight loss intervention.

During the first two months of the program, participants who were stepped twice because they missed weight loss goals and had the least satisfactory performance were more likely to engage in emotional eating (“stress and depression” barriers) than participants who were never stepped. These findings are consistent with research indicating an association between emotional eating and poor weight loss outcomes (Braden et al., 2016; Frayn & Knäuper, 2017). Once-stepped participants were in the expected direction and combined stepped participants reported greater stress and depression barriers than non-stepped participants. In the current investigation, stress and depression as barriers to healthy eating were unrelated to attrition, stepped group, or weight loss at any other time point.

Cost of diet food was the only barrier related to total percentage of bodyweight lost. Participants who reported an inability to purchase healthy food in prior weight loss attempts and during the first two months lost less weight overall. The affordability of healthy food has been previously cited in the literature as an important barrier to successful weight loss (Baruth, 2014; Kruger, Blanck, & Gillespie, 2006; Cassady, Jetter, & Culp, 2007; Moredich & Kessler 2014). Interestingly, however, there was not a significant relationship between income and weight loss in this investigation. Of course, income may not always perfectly reflect money available to use toward food. Alternatively, some individuals may perceive the cost of healthy foods as a significant barrier to purchasing them despite their level of income.

Depression Symptoms

In examining depressive symptoms and attrition, stepped-status, and weight loss outcomes, only one associate was significant. Completers reported higher depression scores at month four relative to non-completers. While this finding was statistically significant, this could be more of a reflection of the much smaller sample of droppers ($N = 3$) at this point in the

program. While not directly related to the outcomes examined, post hoc analyses revealed depression was significantly correlated with social support and barriers (see Table 5). Generally, depression scores were negatively correlated with most social support reports, except for instrumental frequency ($r = .40, p = .008$). Instrumental support refers to others' involvement in helping the individual to lose weight, such as exercising with the individual and following a weight loss diet with them. Perhaps family and friends offer this type of tangible help more for individuals with more symptoms of depression, because they demonstrate a lack of initiative to engage in weight loss behaviors independently. Another interesting relationship existed between depression and internal physical activity barriers at the end of the study ($r = .32, p = .04$). Internal physical activity barriers include pain, lack of energy, and lack of motivation to exercise. It would be expected that individuals experiencing depressive symptoms would experience fatigue and low motivation as exercise barriers; further, the experience of physical pain may contribute to feelings of depression if the pain prevents individuals from engaging in activities they enjoy.

Social Support

The hypothesis that participants who performed better during the weight loss program would report a greater frequency and helpfulness of social support was based on the literature of the importance of social support for successful weight loss. It was speculated that receiving more social support and finding social support to be helpful would be related to successful weight loss outcomes. However, many of the findings regarding social support were unexpected. Generally speaking, it was perplexing to find that people who did well in the program reported certain types of social support to be less helpful than people who did poorly. While perplexing, an attempt is nevertheless given to explain and understand these confusing findings.

It is also important to acknowledge that the greater frequency and helpfulness of certain social support types that were associated with worse participant outcomes may have been partially confounded by the receipt of support via the stepped-care mechanism. For example, twice-stepped participants reported receiving more emotional support than non-stepped participants during the last two months of the program. Additionally, twice stepped participants were eligible to receive individual counseling throughout the last two months which could be perceived as additional emotional support. Interestingly, this greater support may have actually translated to improved outcomes. Twice-stepped participants initially reported greater barriers related to emotional eating (“stress and depression” barriers) during the first two months of the program. During months 3 and 4, while receiving meal replacements, twice stepped participants evidenced a 1.0% weight gain. These same participants lost 1.2% body weight during months 5 and 6 of individual counseling (Carels et al., 2017). Ultimately, it is not known whether the twice stepped participants were able to gain control over emotional eating because of participation in counseling and subsequently were able to reverse weight gain trajectory and achieve some modest weight loss. Future studies may want to examine directly whether brief counseling is effective at reducing the negative impact of emotional eating on weight loss outcomes.

In another perplexing finding, participants who dropped out of the program perceived certain types of support to be more helpful than completers during the first two months of the program. Informational support (i.e., types of exercises to do, calorie and fat content of foods, and other weight loss tips) and appraisal support (i.e., compliments about their weight loss progress and ability to maintain an exercise routine) were reported as more helpful by drop-outs than completers despite no differences in the frequency of support received in these areas. The

lack of a difference in the receipt of this type of support argues against the idea that people who dropped out were not receiving a critical form of support that they desire relative to people that completed the program. The support questions asked how helpful something was when it happened and how often they received it. Unfortunately, neither of the requested responses answers the critical question of whether they received sufficient quantities of this support. A higher helpfulness score may reflect a greater need for this type of support. It is plausible that these participants did not receive sufficient quantities of two important types of support that would have helped to keep them in the program. It is also plausible that during the early self-help phase of treatment, some individuals actually desired more information about weight loss and more compliments and encouragement from people in their lives, etc., particularly those at risk of dropping out. The completers may have been more knowledgeable about weight loss and did not require external appraisals to remain in the program. The notion that certain types of support may be needed at different times during a weight loss intervention is interesting and an important area of further inquiry.

In addition to supporting the notion that informational and appraisal types of support are more important than other forms of support during the initial portion of a weight loss program, these findings also appear to relate to the role of health literacy and weight loss observed in prior research with this sample. The difference in reports of informational support helpfulness between completers and drop-outs may be related to drop-outs reporting lower levels of health literacy than completers ($p = .09$; Carels, Selensky, Rossi, Solar, & Hlavka, 2017). Post-hoc analyses showed that lower health literacy was related to greater helpfulness of emotional support in previous weight loss efforts ($r = -.354, p = .043$), greater frequency of information support in the first two months ($r = -.360, p = .022$), and greater frequency of appraisal support

in the first two months ($r = -.511, p = .001$). A plausible speculation concerns the use of self-help during the first two months of the program; the current study provided participants with a self-help modified version of the DPP. For low-health literacy participants, the DPP alone may have been insufficient or too complicated to comprehend and implement on their own. As such, these participants would have found the receipt of additional support helpful. The informational support may have served to supplement and explain the health knowledge needed to make behavioral changes for weight loss. The appraisal support may have served to reinforce the progress resulting from their efforts. Further, participants lower in health literacy reported that emotional support was more helpful in the past, which would serve to encourage and enhance their confidence during the challenging process of weight loss. In short, greater informational, appraisal, and emotional support at the start of the intervention would have been perceived as helpful to lower health-literacy participants who eventually went on to drop out.

It is intriguing that health literacy was unrelated to any social support frequency or helpfulness reports in months 3-6. A possible explanation is that many of the participants who were low in health literacy dropped out before the month four assessment. In fact, post-hoc analyses confirmed this hypothesis. The participants who had dropped out by month four were significantly lower in health literacy ($M = 4.5$) than participants who remained in the program during months 3-6 ($M = 5.4, p = .03$). Health literacy as a main factor relating to attrition is important to note, and this was explored in greater detail in Carels et al. (2017).

Furthermore, receiving more informational support in the last two months and reporting lower health literacy were associated with worse weight loss outcomes. While this suggested a potential relationship between informational support and health literacy, post-hoc analyses uncovered no significant relationships between health literacy and any type of social support in

the last two months. However, as mentioned above, during the first two months lower health literacy was significantly associated with a greater frequency of informational support ($r = -.360$, $p = .022$). The literature supports the idea that individuals with low health literacy are likely to seek out the greater social support that they need (Osborn, Bains, & Egede, 2010). There is a dearth of literature on the relationship between social support, health literacy, and weight loss. While the current findings are not entirely clear, they suggest that a relationship does exist between social support, health literacy, and weight loss outcomes.

Another possible explanation for the relationship between the report of less informational support during months five and six and greater weight loss is related to the temporal factor of this relationship. It is plausible that during the final two months of the study, participants who achieved good weight loss outcomes likely already consumed the knowledge they needed to make such behavioral changes by the end of the intervention. These participants were no longer seeking knowledge from others and, therefore, received less informational support during this time. Others may also have been observing how well they were doing and were less likely to offer informational type of support to individuals who were doing well.

Changes over Time

Exploratory analyses were conducted to assess potential changes in depression, social support, and barriers over the course of a weight loss program. It was speculated that people may experience different struggles and barriers at different points in treatment. For example, it was speculated that internal physical activity barriers (i.e., lack of motivation) may have increased throughout the program, or that barriers overall may have been reduced in later months due to the distribution of greater treatment intensity to those who needed it (i.e., Wang, Zheng, & Burke, 2015). Interestingly, participants did not report changes in specific barriers throughout

the current study. It is possible that the reported barriers remained fairly constant over the six months. In other words, something that bothered a participant at month two was still bothering him or her at month six, despite changes in treatment intensity as needed for some participants. It is also plausible that DPP program was unsuccessful at helping participants to overcome their barriers throughout treatment. Finally, it is possible that variables that may change over time during a weight loss intervention were not assessed in this study.

Participants reported higher barrier scores on previous weight loss efforts than at any time point during the study. There are several possible explanations for this finding. First, there is the potential for recall bias; participants may recall certain factors as more important or more negative than they actually were. There are several factors that may influence recall bias and accuracy, such as the content and form of the question asked (Coughlin, 1990). Participants about to begin a new weight loss attempt were asked to recall their previous weight loss effort, which may have influenced participants to reflect on how their last attempt failed. Thinking about this failure may have led to higher reports of barriers, for example. It is also possible that taking part in a formal stepped-care weight loss program reduced barriers associated with prior attempts. Finally, previous barrier conditions may have improved since participants' last weight loss attempt. In other words, participants may have elected to take part in a weight loss program because they perceived that they were experiencing fewer barriers than in past weight loss attempts.

Similarly, there were no changes in report of depressive symptomology over time, but the report of emotional support helpfulness and informational support helpfulness increased from month two to month six. It was speculated that this effect might be secondary to the receipt of counseling by some participants. Therefore, additional, post-hoc tests were conducted to

determine whether these changes in support over time were only among the twice-stepped participants receiving counseling. Contrary to this speculation, increases in emotional and informational helpfulness from month two to month six were seen in non-stepped and once-stepped participants. In fact, helpfulness of emotional support decreased and helpfulness of informational support remained the same over time for twice-stepped participants. Perhaps, non- and once-stepped participants were able to ask for the support they needed outside of the program and therefore found it to be helpful. In contrast, because twice-stepped participants were receiving counseling, their reports of a decrease in helpfulness of emotional support could reflect the perception that emotional support from others was less helpful since they began to receive counseling.

Strengths

An examination of barriers, depression, and social support in a stepped-care behavioral weight loss intervention is novel. The assessment of variables at four different time points over the six-month period of the program provided rich data. Identifying some of the differences between participants who dropped out vs. completed and participants who received stepped-care vs. remained in self-help informs future weight loss programs by suggesting effective ways to identify participants who may need more intensive care earlier on and intervene appropriately. Attrition is a significant problem in weight loss programs, and the current investigation's findings contributed to the knowledge of factors that may differentiate participants who complete and drop out of a weight loss intervention.

Limitations

The 28% attrition rate in an initially small sample presented an important limitation in this study because of the increasingly small group sizes at later time points. However, this rate

of attrition is not uncommon for weight loss research. Other weight loss interventions report similar or much greater rates of attrition (Cheskin et al., 2008; Grave et al., 2005; Honas, Early, Frederickson, & O'Brien, 2003; Teixeira et al., 2004; Tsai & Wadden, 2005; Wing & Jeffery, 1999). In fact, the high attrition rates reported in weight loss literature was an important incentive for the current investigation's objectives. Also, the mostly Caucasian female sample may limit the generalizability of the results to other populations. Further, a future study on barriers to weight loss interventions might reconsider the assessment of barriers. No well-validated assessments of weight loss barriers currently exists. In fact, the version of Sherifi et al. (2014)'s barrier measure used in the current study was created in another country (Iran). As such, several items' wording was adjusted to better apply to the current sample. While this measure did appear to map onto many important barriers reported in past research (Baruth, et al., 2014; Ciao, Latner, & Durso, 2012; Leone & Ward, 2013), future research into the assessment of weight loss barriers is clearly warranted.

Future Considerations

The current investigation's findings may be clinically significant and indicate a need for assessment and intervention to resolve barriers to weight loss during the initial stages of a weight loss intervention. Participants who report greater social pressure and food cravings may be particularly vulnerable to terminating a weight loss program. This may suggest that the completers of the current study were more successful in limiting their caloric intake in the first two months of the program since they reported less temptation to stray from their weight loss diet. Caloric restriction, restriction of craved foods, and teaching participants skills for coping with their cravings may be beneficial to reduce frustration, attrition, and ultimately improve outcomes in future weight loss programs. While drop-outs are rarely examined in weight loss

treatment outcome research, uncovering barriers that lead individuals to give up on their weight loss efforts is crucial for widespread reduction of obesity rates.

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| <i>Table 1 Group Differences by Attrition</i> | | | | | | |
|---|-----------------------|---------------------|-----------------------|---------------------|-------------------------|-------------------------|
| Variables | Baseline | | Month 2 | | Month 4 | |
| | Completed (N = 37) | Dropped (N = 13) | Completed (N = 38) | Dropped (N = 12) | Completed (N = 34) | Dropped (N = 5) |
| Depression | 11.1 (8.1) | 11.8 (6.5) | 6.9 (5.1) | 6.5 (3.6) | 8.1 (5.3)**† | 4.4 (1.8)**† |
| Social Support | | | | | | |
| Emotional (F) | .9 (.7) | 1.1 (.5) | 1.0 (.7) | 1.1 (.8) | .8 (.6) | .7 (.3) |
| Emotional (H) | 1.7 (1.0) | 2.0 (.8) | 1.4 (.8) | 2.0 (1.2) | 1.7 (.9) | 1.3 (.7) |
| Instrumental (F) | 1.0 (.7) | .9 (.5) | 1.2 (.9) | .9 (.8) | 1.0 (.7) | .8 (.4) |
| Instrumental (H) | 2.2 (1.3) | 2.5 (1.0) | 2.0 (1.0) | 2.6 (1.1) | 2.2 (1.1) | 2.1 (.5) |
| Informational (F) | .7 (.7) | 1.0 (.9) | .7 (.6) | 1.0 (.8) | .7 (.8) | .5 (.8) |
| Informational (H) | 1.7 (1.1) | 2.0 (1.1) | 1.3 (1.0)* | 2.1 (1.3)* | 1.8 (1.2) | 1.1 (1.0) |
| Appraisal (F) | .7 (.8) | 1.0 (.7) | .9 (1.0) | .9 (.9) | 1.0 (1.0) | .4 (.4) |
| Appraisal (H) | 2.2 (1.3) | 2.6 (1.0) | 1.9 (1.2)* | 2.7 (1.2)* | 2.3 (1.1) | 2.0 (1.1) |
| Barriers | | | | | | |
| Situational | 3.3 (1.2) | 3.9 (.9) | 2.7 (1.1) | 3.2 (.8) | 2.8 (1.2) | 3.4 (.9) |
| Stress/Depression | 3.2 (1.5) | 2.8 (1.1) | 2.3 (1.1) | 2.3 (1.2) | 2.4 (1.3) | 1.9 (.7) |
| Social Pressure | 2.4 (1.2)*† | 3.1 (.8)*† | 1.5 (.6)* | 2.0 (.9)* | 1.8 (.7) | 2.2 (.8) |
| Adverse Effects | 2.3 (.9) | 2.9 (1.0) | 1.6 (.6) | 1.6 (.4) | 1.6 (.7) | 1.3 (.2) |
| Food Craving | 2.2 (.9) | 2.8 (.9) | 1.7 (.5)** | 2.3 (.6)** | 2.0 (.7) | 2.3 (.4) |
| Cost of Diet | 2.1 (1.0) | 2.2 (.9) | 1.8 (.7) | 2.1 (.9) | 1.8 (1.0) | 1.2 (.3) |
| External PA | 2.5 (1.0) | 2.7 (.5) | 2.0 (.8) | 2.3 (.6) | 1.9 (.9) | 1.8 (.5) |
| Internal PA | 1.9 (.5) | 2.1 (.5) | 1.5 (.4) | 1.7 (.5) | 1.6 (.6) | 1.4 (.3) |
| Total Barriers | 68.1 (21.1) | 76.9 (10.0) | 51.3 (14.0)* | 60.0 (8.1)* | 54.4 (17.1) | 53.4 (6.9) |
| <p><i>Note. F = frequency, H = helpfulness. Significant differences between groups within each time point denoted by * p < .05, ** p < .01, *** p < .001. † denotes adjusted degrees of freedom due to a violation of Levene's test of equal variance. Depression measured by CES-D 10. Social support factors measured by WMSI. Barriers measured by variation of Sherifi et al. scale. Dropped = participants who dropped out at some point during the study. Some participants who dropped prior to month 2 or 4 still completed the questionnaires at home prior to cancelling their assessment appointment.</i></p> | | | | | | |

| Variables | Baseline | | | Month 2 | | | Month 4 | | | Month 6 | | |
|-----------------------|--------------------|------------------|--------------------|---------------------|---------------------|--------------------|-----------------|-----------------|-------------------|-----------------|-----------------|-------------------|
| | Non (N = 15) | Once (N = 10) | Twice (N = 16) | Non (N = 15) | Once (N = 10) | Twice (N = 16) | Non (N = 15) | Once (N = 9) | Twice (N = 12) | Non (N = 15) | Once (N = 8) | Twice (N = 15) |
| Depression | 5.6 (4.3) | 5.1 (2.5) | 5.6 (4.4) | 6.3 (5.9) | 6.4 (5.2) | 7.4 (4.0) | 7.4 (6.0) | 7.3 (3.7) | 8.7 (5.7) | 5.7 (4.8) | 6.1 (3.8) | 5.3 (3.8) |
| Social Support | | | | | | | | | | | | |
| Emotional (F) | 1.0 (.8) | .8 (.6) | 1.0 (.5) | .8 (.6) | .8 (.7) | 1.2 (.8) | .7 (.6) | .6 (.5) | .9 (.6) | .6 (.5)* | .8 (.5) | 1.1 (.7)* |
| Emotional (H) | 1.5 (1.2) | 1.8 (1.2) | 1.8 (.5) | 1.1 (.9) | 1.5 (1.0) | 1.7 (.7) | 1.6 (.7) | 1.3 (.8) | 2.1 (1.0) | 1.6 (.8) | 2.2 (.9) | 1.5 (.8) |
| Instrumental (F) | 1.2 (.7) | .7 (.6) | 1.0 (.6) | 1.2 (1.0) | .8 (.5) | 1.4 (.9) | 1.1 (.7) | .6 (.6) | 1.2 (.7) | 1.2 (.8) | .9 (.7) | 1.4 (.8) |
| Instrumental (H) | 2.3 (1.2) | 2.2 (1.5) | 2.4 (1.0) | 2.0 (1.1) | 2.3 (1.1) | 2.0 (.9) | 2.4 (.8) | 1.7 (1.3) | 2.4 (1.1) | 2.3 (1.3) | 2.9 (.7) | 2.1 (1.0) |
| Informational (F) | .9 (.8) | .7 (.8) | .7 (.4) | .6 (.5) | .5 (.6) | .7 (1.0) | .7 (1.0) | .4 (.5) | 1.0 (.7) | .5 (.6) | .6 (.6) | 1.0 (.8) |
| Informational (H) | 1.3 (1.1) | 1.9 (1.4) | 2.0 (.9) | 1.0 (.9) | 1.5 (1.4) | 1.6 (.9) | 1.6 (1.1) | 1.2 (1.0) | 2.1 (1.4) | 1.8 (1.2) | 2.2 (1.2) | 1.5 (1.0) |
| Appraisal (F) | .9 (1.0) | .4 (.5) | .7 (.6) | 1.1 (1.0) | .5 (.4) | 1.0 (1.1) | 1.4 (1.2) | .8 (.7) | .6 (.5) | 1.3 (1.2) | 1.0 (.8) | .8 (.7) |
| Appraisal (H) | 2.4 (1.5) | 2.2 (1.4) | 2.5 (.9) | 2.0 (1.3) | 2.0 (1.4) | 1.9 (1.0) | 2.5 (1.0) | 1.9 (1.2) | 2.2 (1.2) | 2.8 (1.0) | 2.9 (.9) | 2.1 (1.0) |
| Barriers | | | | | | | | | | | | |
| Situational | 2.8 (1.4)*† | 4.1 (.8) | 3.4 (1.2)*† | 2.5 (1.1) | 3.4 (1.0) | 2.6 (1.1) | 2.7 (1.1) | 3.2 (.9) | 2.7 (1.3) | 2.8 (1.3) | 3.2 (1.2) | 2.4 (1.2) |
| Stress and Depression | 2.7 (1.4) | 3.8 (1.2) | 3.0 (1.7) | 1.7 (.8)*† | 2.7 (.7) | 2.7 (1.3)*† | 2.3 (1.5) | 2.1 (.6) | 2.6 (1.4) | 2.4 (1.5) | 2.8 (1.3) | 2.4 (1.1) |
| Social Pressure | 2.4 (1.2) | 2.8 (1.1) | 2.2 (1.3) | 1.5 (.6) | 1.9 (.8) | 1.5 (.6) | 1.7 (.7) | 1.9 (.8) | 2.0 (.9) | 1.6 (.7) | 2.3 (1.5) | 1.6 (.6) |
| Adverse Effect | 2.1 (.8) | 2.6 (.8) | 2.2 (1.0) | 1.4 (.4) | 1.9 (.7) | 1.6 (.8) | 1.5 (.5) | 1.3 (.3) | 1.9 (.9) | 1.5 (.6) | 1.8 (.8) | 1.6 (.7) |
| Food Craving | 2.1 (1.1) | 2.8 (.9) | 2.2 (.7) | 1.5 (.4)* | 2.1 (.5)* | 1.8 (.5) | 1.8 (.6) | 2.1 (.4) | 2.2 (.8) | 2.0 (.7) | 2.2 (1.1) | 1.5 (.7) |
| Cost of Diet | 1.7 (.7) | 2.4 (1.1) | 2.1 (1.0) | 1.5 (.7) | 1.8 (.5) | 1.9 (.7) | 1.4 (.8) | 1.6 (.5) | 2.3 (1.3) | 1.7 (.8) | 1.9 (1.2) | 1.8 (.9) |
| External PA | 2.2 (.9)* | 3.1 (.7)* | 2.4 (.9) | 1.8 (.9) | 2.3 (.7) | 2.0 (.7) | 1.7 (.8) | 2.1 (.8) | 2.1 (.8) | 1.7 (.6) | 2.3 (1.0) | 1.8 (.9) |
| Internal PA | 1.8 (.6) | 2.1 (.3) | 1.9 (.6) | 1.4 (.5) | 1.5 (.4) | 1.7 (.4) | 1.5 (.4) | 1.6 (.5) | 1.8 (.7) | 1.5 (.5) | 1.5 (.4) | 1.6 (.5) |
| Total Barriers | 61.2 (21.7) | 80.7 (11.1) | 66.7 (21.7) | 45.9 (13.5)* | 59.4 (11.0)* | 53.6 (14.0) | 50.4 (14.5) | 55.1 (12.2) | 59.0 (21.3) | 51.6 (11.3) | 60.7 (20.4) | 49.7 (16.4) |

Note. F = frequency, H = helpfulness. Significant differences between groups within each time point denoted by * p < .05, ** p < .01, *** p < .001. † denotes adjusted degrees of freedom due to a violation of Levene's test of equal variance. Depression measured by CES-D (baseline and month 6) and CES-D 10 (months 2 and 4). Social support factors measured by WMSI. Barriers measured by variation of Sheriff et al. scale.

Table 3 Group Differences between Non-Stepped and Stepped (Once- and Twice-Stepped Combined)

| Variables | Baseline | | Month 2 | | Month 4 | | Month 6 | |
|-----------------------|--------------------|--------------------|---------------------|---------------------|--------------------|------------------|-----------------|------------------|
| | Non (N = 15) | Step (N = 26) | Non (N = 15) | Step (N = 26) | Non (N = 15) | Step (N = 21) | Non (N = 15) | Step (N = 23) |
| Depression | 5.6 (4.3) | 5.4 (3.7) | 6.3 (5.9) | 7.0 (4.3) | 7.4 (6.0) | 8.1 (4.8) | 5.7 (4.8) | 5.6 (3.8) |
| Social Support | | | | | | | | |
| Emotional (F) | 1.0 (.8) | .9 (.6) | .8 (.6) | 1.1 (.8) | .7 (.6) | .8 (.6) | .6 (.5)* | 1.0 (.7)* |
| Emotional (H) | 1.5 (1.2) | 1.8 (.9) | 1.1 (.9)* | 1.7 (.8)* | 1.6 (.7) | 1.7 (1.0) | 1.6 (.8) | 1.8 (.9) |
| Instrumental (F) | 1.2 (.7) | .8 (.6) | 1.2 (1.0) | 1.1 (.8) | 1.1 (.7) | .9 (.7) | 1.2 (.8) | 1.2 (.8) |
| Instrumental (H) | 2.3 (1.2) | 2.3 (1.3) | 2.0 (1.1) | 2.1 (1.0) | 2.4 (.8) | 2.1 (1.2) | 2.3 (1.3) | 2.4 (1.0) |
| Informational (F) | .9 (.8) | .7 (.6) | .6 (.5) | .8 (.7) | .7 (1.0) | .7 (.7) | .5 (.6) | .8 (.7) |
| Informational (H) | 1.3 (1.1) | 2.0 (1.1) | 1.0 (.9) | 1.5 (1.1) | 1.6 (1.1) | 1.8 (1.3) | 1.8 (1.2) | 1.8 (1.1) |
| Appraisal (F) | .9 (1.0) | .6 (.6) | 1.1 (1.0) | .8 (.9) | 1.4 (1.2)*† | .7 (.6)*† | 1.3 (1.2) | .9 (.8) |
| Appraisal (H) | 2.4 (1.5) | 2.3 (1.1) | 2.0 (1.3) | 2.0 (1.2) | 2.5 (1.0) | 2.1 (1.1) | 2.8 (1.0) | 2.4 (1.0) |
| Barriers | | | | | | | | |
| Situational | 2.8 (1.4)*† | 3.7 (1.0)*† | 2.5 (1.1) | 2.9 (1.1) | 2.7 (1.1) | 2.9 (1.2) | 2.8 (1.3) | 2.7 (1.2) |
| Stress and Depression | 2.7 (1.4) | 3.4 (1.5) | 1.7 (.8)** | 2.7 (1.1)** | 2.3 (1.5) | 2.4 (1.1) | 2.4 (1.5) | 2.6 (1.2) |
| Social Pressure | 2.4 (1.2) | 2.5 (1.2) | 1.5 (.6) | 1.7 (.7) | 1.7 (.7) | 2.0 (.8) | 1.6 (.7) | 1.9 (1.1) |
| Adverse Effect | 2.1 (.8) | 2.4 (.9) | 1.4 (.4) | 1.7 (.7) | 1.5 (.5) | 1.6 (.8) | 1.5 (.6) | 1.6 (.8) |
| Food Craving | 2.1 (1.1) | 2.4 (.8) | 1.5 (.4)* | 1.9 (.6)* | 1.8 (.6) | 2.1 (.7) | 2.0 (.7) | 1.8 (.9) |
| Cost of Diet | 1.7 (.7) | 2.3 (1.1) | 1.5 (.7) | 1.9 (.6) | 1.4 (.8) | 2.0 (1.1) | 1.7 (.8) | 1.8 (1.0) |
| External PA | 2.2 (.9) | 2.7 (.9) | 1.8 (.9) | 2.1 (.7) | 1.7 (.8) | 2.1 (.8) | 1.7 (.6) | 2.0 (.9) |
| Internal PA | 1.8 (.6) | 2.0 (.5) | 1.4 (.5) | 1.6 (.4) | 1.5 (.4) | 1.7 (.6) | 1.5 (.5) | 1.5 (.5) |
| Total Barriers | 61.2 (21.7) | 73.4 (18.5) | 45.9 (13.5)* | 55.8 (13.0)* | 50.4 (14.5) | 57.3 (17.7) | 51.6 (11.3) | 53.9 (18.5) |

*Note. F = frequency, H = helpfulness. Significant differences between groups within each time point denoted by * p < .05, ** p < .01, *** p < .001. † denotes adjusted degrees of freedom due to a violation of Levene's test of equal variance. Depression measured by CES-D (baseline and month 6) and CES-D 10 (months 2 and 4). Social support factors measured by WMSI. Barriers measured by variation of Sherifi et al. scale.*

| <i>Table 4 Barrier Differences by Time</i> | | | | | |
|--|----------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|
| | Baseline (N = 30) | Month 2 (N = 30) | Month 4 (N = 30) | Month 6 (N = 30) | Effect Size (η^2) |
| Depression | 5.7 (4.2) | 6.7 (5.0) | 7.8 (5.4) | 5.8 (4.3) | .199 |
| Social Support | | | | | |
| Emotional (F) | .9 (.6) | .8 (.6) | .7 (.5) | .7 (.5) | .203 |
| Emotional (H) | 1.7 (1.0) | 1.4 (.9) ^A | 1.6 (.8) | 1.9 (.7) ^A | .405 |
| Instrumental (F) | 1.0 (.7) | 1.1 (.9) | 1.0 (.6) | 1.1 (.8) | .053 |
| Instrumental (H) | 2.3 (1.3) | 2.2 (1.0) | 2.3 (1.1) | 2.6 (1.0) | .162 |
| Informational (F) | .8 (.7) | .7 (.7) | .6 (.7) | .7 (.7) | .169 |
| Informational (H) | 1.6 (1.1) | 1.4 (1.1) ^A | 1.6 (1.2) | 1.9 (1.0) ^A | .294 |
| Appraisal (F) | .7 (.8) | .8 (.8) | .9 (.8) | 1.0 (.8) | .106 |
| Appraisal (H) | 2.4 (1.3) | 2.2 (1.2) | 2.5 (1.0) | 2.8 (.8) | .221 |
| Barriers | | | | | |
| Situational | 3.3 (1.2) ^A | 2.7 (1.0) ^A | 2.9 (1.1) | 2.7 (1.2) ^A | .302 |
| Stress/Depression | 3.1 (1.5) ^A | 2.2 (1.0) ^A | 2.4 (1.3) | 2.4 (1.3) | .365 |
| Social Pressure | 2.3 (1.1) ^{ABC} | 1.6 (.7) ^A | 1.8 (.7) ^B | 1.8 (1.0) ^C | .345 |
| Adverse Effects | 2.2 (.8) ^{ABC} | 1.7 (.7) ^A | 1.5 (.6) ^B | 1.6 (.7) ^C | .663 |
| Food Craving | 2.2 (.9) ^A | 1.8 (.5) ^A | 2.0 (.7) | 1.9 (.8) | .310 |
| Cost of Diet | 1.9 (.9) ^A | 1.5 (.5) ^A | 1.5 (.7) | 1.6 (.9) | .284 |
| External PA | 2.5 (.9) ^{AB} | 2.1 (.9) | 2.0 (.9) ^A | 1.9 (.9) ^B | .433 |
| Internal PA | 1.9 (.5) ^{ABC} | 1.5 (.5) ^A | 1.6 (.5) ^B | 1.5 (.4) ^C | .445 |
| Total Barriers | 67.7 (19.7) ^{ABC} | 52.3 (15.0) ^A | 53.6 (17.6) ^B | 52.1 (16.9) ^C | .548 |
| <i>Note. Cells sharing the same superscript are significantly different from each other. F = frequency, H = helpfulness.</i> | | | | | |

| <i>Table 5 Depression Correlations</i> | | | | |
|--|----------------------|---------------------|---------------------|---------------------|
| | Baseline (N = 42) | Month 2 (N = 47) | Month 4 (N = 38) | Month 6 (N = 31) |
| Social Support | | | | |
| Emotional (F) | .10 | -.12 | -.31 | -.12 |
| Emotional (H) | -.08 | .08 | -.39* | -.08 |
| Instrumental (F) | -.49** | -.39** | -.36* | -.44** |
| Instrumental (H) | -.28 | .03 | -.43** | -.13 |
| Informational (F) | -.07 | -.04 | -.30 | -.29 |
| Informational (H) | -.14 | .16 | -.31 | -.13 |
| Appraisal (F) | .00 | -.22 | -.11 | -.18 |
| Appraisal (H) | -.15 | .04 | -.11 | .02 |
| Barriers | | | | |
| Situational | .01 | .06 | -.16 | .18 |
| Stress/Depression | .23 | .52*** | .62*** | .68*** |
| Social Pressure | .09 | .16 | -.06 | .01 |
| Adverse Effects | .25 | .42** | .35* | .19 |
| Food Craving | .11 | .26 | .28 | .33* |
| Cost of Diet | .15 | .14 | .23 | .16 |
| External PA | .08 | .42** | .23 | .26 |
| Internal PA | .09 | .28 | .30 | .32* |
| Total Barriers | .16 | .45** | .29 | .38* |

APPENDIX A



EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building · Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · www.ecu.edu/irb

Notification of Initial Approval: Expedited

From: Social/Behavioral IRB
To: [Robert Carels](#)
CC:
[James Rossi](#)
Date: 11/3/2015
Re: [UMCIRB 15-001766](#)
Study of Weight Stigma, Emotional Eating and of Weight Loss Using a Stepped Care Approach

I am pleased to inform you that your Expedited Application was approved. Approval of the study and any consent form(s) is for the period of 11/2/2015 to 11/1/2016. The research study is eligible for review under expedited category # 4, 7. The Chairperson (or designee) deemed this study no more than minimal risk.

Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The Investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

