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The influence of three short-term weight loss interventions on self-efficacy, decisional balance, and processes of change in obese adults

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The influence of three short-term weight loss interventions on

self-efficacy, decisional balance, and processes of change in obese adults

by

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ABSTRACT

Motivational and psychosocial outcomes have not been reported in behavioral weight loss programs utilizing the SenseWear Pro armband (SWA) and motivational interviewing; making it difficult to identify motivational components that may be related to weight loss. The Transtheoretical Model (TTM) is one model used to help explain motivation and behavior change through the constructs of decisional balance (DB), diet and physical activity self-efficacy (SE), and cognitive and behavioral processes of change (C-POC, B-POC). The purpose of this study was to assess the changes in TTM constructs of DB, SE, and both C-POC and B-POC in a randomized trial evaluating three different weight loss interventions in obese adults.

Seventy-eight subjects (32 males and 46 females) completed one of three 8-week weight loss interventions with guidance from a health coach and the utilization of motivational interviewing techniques. Group 1 ($n = 26$) received a behaviorally guided weight loss program (GWLP), Group 2 ($n = 26$) received a self-monitoring tool called the SenseWear Pro Armband (SWA) with Weight management system (WMS) and Group 3 ($n = 26$) received both programming options (GWLP + SWA). Weight change and changes in TTM constructs of SE, DB (pros vs. cons), and C-POC and B-POC were assessed at baseline and at the completion of the intervention. Changes in variables across time and condition were assessed using multivariate ANOVAs and the magnitude of effects were reported using effect sizes.

All interventions produced significant weight loss, with no significant differences between groups. Significant changes in TTM constructs were observed over time and some differences were evident between groups. Large effect sizes were found for improvements in

SE in groups that received the GWLP (Groups 1 and 3), while slight improvements were seen in the SWA group (Group 2). Decisional balance improved significantly ($p < 0.05$) in the combined GWLP + SWA intervention (Group 3). Significant improvements ($p < 0.001$) over time were evident for specific B-POC: counterconditioning, interpersonal systems control, reinforcement management, self-liberation, and stimulus control.

The results of this study support previous evidence showing improvements in self-efficacy directly after an active intervention, but warrants further examination for identifying which processes of change are influenced via self-monitoring techniques and the use of motivational interviewing techniques on motivational and behavioral outcomes. Longer-term studies are needed to determine if these factors may influence maintenance of weight loss.

CHAPTER 1. GENERAL INFORMATION

Introduction

Physical inactivity and poor diet habits are two modifiable behaviors that contribute to the current global obesity epidemic. Despite considerable efforts, it has been difficult to develop practical and effective behavioral interventions that can promote weight loss and maintenance. The most successful weight loss programs have consistently been achieved through group sessions and typically result in 8–10% weight loss over a 6-month period (Wadden and Butryn 2003), but these can be time consuming and costly. The development of new technology, access to computers, and self-monitoring devices has led to new approaches for delivering behavioral weight loss interventions.

The goal of behavior treatment is to help an individual identify how to change unhealthy behaviors by establishing new healthy behaviors (Foster, Makris, & Bailer, 2005). Self-monitoring of diet and exercise behaviors make up the primary components of behavior modification and will be discussed further in the review of literature. Self-monitoring alone is considered the core behavioral skill in behavior programs and may facilitate the adoption and maintenance of weight control behaviors (Burke et al., 2008). Through the use of self-monitoring, an individual becomes more aware of daily habits and antecedents to behaviors that may contribute to unhealthy choices. Increased awareness of diet and physical activity behaviors identified using self-monitoring may also change thoughts and decision-making skills related to weight control.

There are a variety of tools and web-based resources designed to facilitate self-monitoring, though there is no consensus on the most effective approaches. A particularly

promising self-monitoring tool is the SenseWear Pro 3 (SWA) monitoring device (BodyMedia, Inc.). This commercially available self-monitoring device, which is worn on the upper arm, monitors physical activity and accurately predicts total daily energy expenditure in healthy adults (Johannsen et al., 2010). A watch interface enables participants to monitor physical activity and caloric expenditure during the day. An associated software program called the Weight Management System (WMS) allows individuals to keep a diet record using an online food database. The immediate feedback from the SWA watch in combination with the WMS allows individuals to track energy balance patterns. A recent study by Polzien et al. (2007) revealed that individuals who continuously wore the armband during a 12-week intervention had significant weight loss compared to those with no armband or inconsistent use of the armband. Another study (Shugar et al., 2011) revealed that the SWA was as effective as guidance from counselors but additional research is needed to replicate these findings. In particular, further research is needed to assess the impact of the SWA self-monitoring tools influence on motivational constructs and behavior change; both alone and in combination with behaviorally based programming.

An additional strategy that has been identified as a successful facilitator of weight control is motivational interviewing (MI). Motivational interviewing is a client-centered counseling approach aimed at decreasing ambivalence and increasing self-efficacy for specific behaviors that help promote weight loss. Motivational interviewing in weight loss programs emphasizes building SE for diet and physical activity behaviors through helping the client set realistic goals and identify and work through problem behaviors. This technique has been applied through Internet (Webber, Tate, Quintillani, 2008), telephone (Shaikh et al., 2011), and face-to-face (West et al 2011) contact. Carels et al (2007) found that individuals

in a behaviorally guided weight loss (BGWL) program with MI improved dietary and physical activity behaviors and lost more weight than those in a BGWL only program. Motivational interviewing has also been shown to improve adherence to programs (Smith et al., 1997).

The present study was designed to evaluate behavior change strategies in guided weight loss programming that utilize self-monitoring and motivational interviewing techniques. The study randomly assigned overweight adult participants into one of three intervention groups: 1) a behaviorally based, guided weight loss program (GWLP), 2) a self-monitoring program using the SenseWear Pro Armband (SWA) and Weight Management System (WMS) software or 3) a combined GWLP + SWA program. The GWLP program (Group 1) focused on educating participants via weekly behavior skills and motivational interviewing techniques provided by the health coach, while the SWA group (Group 2) relied on the independent feedback of the SWA and WMS (and limited guidance from the health coach). It was theorized that the group receiving both treatments (Group 3) would have the greatest weight loss, but Walsh (2011) recently reported no significant differences in weight loss outcomes between the three treatment groups. This suggests that the use of the SWA was as effective as the more intensive health coaching intervention. The examination of changes in motivational and behavioral constructs may help explain decision-making and behavior change in the participants.

Purpose of Study

The specific goal of the study was to assess motivational and behavioral constructs associated with behavior change and weight loss outcomes using the Transtheoretical Model

(TTM). The primary constructs of the TTM include stages of change (1) precontemplation; no intention to change, 2) contemplation; consideration to change, 3) preparation; taking small steps to change, 4) action; applying new behaviors, and 5) maintenance; accomplishing changed behaviors over time), self-efficacy (situation specific belief in ability to perform a task), decisional balance (perceived benefits and barriers to behavior change), and processes of change (cognitive and behavioral processes used to mediate change). This model has been applied to diet and exercise interventions (Sarkin et al 2001, Carpenter, Finley, Barlow 2004), and has helped categorize and attempt to explain how individuals change. Of these constructs, self-efficacy (SE) has received the most attention and has been shown to predict behaviors contributing to weight loss (Linde, 2008). The construct of decisional balance (DB) is used to show the impact of changes in the Pros (benefits) and Cons (barriers) to change. Both DB and SE have been utilized to help explain changes in behavior (Pinto et al 1999). Processes of change (POC) have been the least frequently examined constructs but they may be the most important for intervention development (Horwath 1999). Most studies evaluating weight loss interventions fail to include psychosocial measures that help explain how change occurs leaving it difficult to create successful interventions for individuals that result in long term weight maintenance.

A better understanding of motivational and behavioral constructs related to weight loss may help to improve the effectiveness of future behavior change programs. The purpose of this study was to address these goals by assessing stages of change (SOC) and measuring changes in DB, SE, and POC before and after the 8-week intervention. There were two specific aims for the study:

1. Determine the impact of each intervention on SE, DB, and POC for weight control behavior change. It was hypothesized that participants in the GWLP and GWLP + SWA groups would have greater improvements in a) SE, b) DB and c) Behavioral POC than participants in the SWA only intervention. In particular, it was hypothesized that behavioral processes would have stronger associations with weight loss than cognitive processes.

2. Determine the relationship between these TTM variables with weight loss outcomes. It was hypothesized that participants with greater weight loss changes would also have larger improvements in SE, DB, and behavioral POC.

Thesis Organization

This thesis is organized into five chapters. Chapter 1 contains a general introduction to the topic and a rationale for the study. Chapter 2 provides a literature review that summarizes issues relevant to the obesity epidemic, theoretical components of the Transtheoretical Model, and behavioral processes used to facilitate change in the overweight and obese individuals; specifically self-monitoring and motivational interviewing. Chapter 3 provides a detailed explanation of the methods, Chapter 4 provides a summary of results, and Chapter 5 provides an overview of the findings along with the major conclusions of the study.

CHAPTER 2. REVIEW OF LITERATURE

This literature review focuses on the issues relevant to the obesity epidemic and theoretical components of decisional balance (DB), self-efficacy (SE) for diet and physical activity, and the processes of change (POC) from the Transtheoretical Model (TTM). An emphasis is placed on the utilization of self-monitoring and motivational interviewing (MI) as primary components used to explain how people change. Minimal research has been done to evaluate the effectiveness of the SWA and WMS system for use as a self-monitoring system on behavior change.

Prevalence of Obesity

Obesity is one of the leading preventable causes of death in the United States, contributing to 112,000 excess deaths based and close to 150 billion dollars on health care costs (Flegal et al., 2005; Finkelstein et al., 2009). The term "obesogenic" has been used to characterize unhealthy environments that increase consumption of unhealthy food and the adoption of sedentary lifestyles. Since 1984, the Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) have collected data on risk behaviors and weight status across the country. During this time, there has been a dramatic increase in the rate of obesity and health risks. In 1990 the prevalence of obesity was less than 10% in 10 of U.S. states. Twenty years later the prevalence has increased two fold. In the 2010 BRFSS prevalence reports of overweight and obesity, no state was below 20% and 30 states had obesity rates greater than 25% (BRFSS, 2010), with prevalence being highest in the Southern and Midwestern states of the U.S.

The standard method for evaluating weight status is with the computed Body Mass Index (BMI). The BMI is often calculated by dividing weight in kilograms by height in meters squared. A value of 25 to 30 kg/m^2 is used to classify a person as overweight while values greater or equal to 30 are used to classify a person as obese (Sullivan et al., 2005). Research has shown that as individuals become overweight or obese there is an increased risk for multiple diseases including coronary heart disease, type 2 diabetes, cancer, hypertension, stroke, sleep apnea, and other health problems (NIH, 1998).

The behavioral treatment of obesity is comprised of three primary components: diet, physical activity, and behavior therapy. Behavior therapy consists of techniques and skills designed to help individuals identify and solve problems leading to poor diet choices and physical inactivity (Wadden and Foster, 2000). A recent review by Ross and Bradshaw (2009) emphasized the important role positive lifestyle changes play on health, despite significant weight changes in obese individuals. The emphasis on total weight loss and "ideal weight" is now shifting to an emphasis on overall behavior changes in diet and increased physical activity that lead to long-term lifestyle changes (Ross and Bradshaw 2009). This multidimensional approach has been identified as the most successful method to help with behavior change (Wadden and Foster, 2000).

The ability to change a behavior depends heavily on self-regulation and motivation of an individual (Thompson et al. 2007). The National Weight Control Registry (a registry of individuals who have had successful weight maintenance for over five years) provides insights about factors that influence weight control. Those who maintained weight loss were physically active, tracked diet and weight regularly and had a good social support system

(Klem et al., 1997). A variety of behavioral theories have been proposed to understand factors influencing behavior change and improve future interventions.

Application of Theory in Behavioral Therapy Interventions

To advance research on obesity treatment and the adoption of healthy lifestyles it is important to measure behavioral processes that may influence behavior change. Identifying specific behaviors that are associated with weight loss may allow interventions to be specifically adapted to different individuals based on baseline assessment of the readiness to change by the individual. The well-established Transtheoretical Model, created by James Prochaska, is one of the most widely used models for behavior interventions in clinical research. It has been used in behavior interventions for smoking, stress, alcohol, exercise, eating disorders, high-fat diets (Glanz, Rimer, Lewis, 1999). This study utilized the Transtheoretical Model (TTM) to examine motivational and behavioral processes so additional detail is provided about this model.

Transtheoretical Model

The TTM, a model of intentional change, is one of the most commonly applied models for behavior change. It is described by Prochaska as "*a theoretical model of behavior change, which has been the basis for developing effective interventions to promote health behavior change*" (Diclemente and Prochaska 1982). The TTM is an integrated theory composed of key constructs of other behavioral theories, which classifies individuals to a one of five stages based on motivation and readiness to change (Bock et al., 1998). Stages include (1) precontemplation; no intention to change, 2) contemplation; consideration to change, 3) preparation; taking small steps to change, 4) action; applying new behaviors, and 5)

maintenance; accomplishing changed behaviors over time. Interventions utilizing stages of change (SOC) were originally applied for smoking cessation programs (Diclemente and Prochaska 1982). Other constructs include self-efficacy (SE), decisional balance (DB), and processes of change (POC). In order to assess a person's motivation, DB and SE are measured for a specific behavior. Decisional balance is the weighting of benefits (Pro) and barriers (Con) perceived by an individual to initiate change, and SE is an indicator of the individual's confidence to perform a specific task. Once a person's motivation is assessed, application of methods to help a person change can be applied. These methods are explained as cognitive and behavioral POC within the TTM. The Cancer Prevention Research Center (CPRC), in Rhode Island has developed scales to assess specific problem behaviors based on TTM constructs, specifically for weight control DB and POC, while SE scales were developed for this specific intervention. The TTM constructs of DB and SE have been used to identify motivation, while and POC attempt to explain change throughout interventions. It is important to further assess these constructs of change to advance knowledge on successful weight loss interventions for obese individuals.

Self-Efficacy

Self-efficacy (SE), a primary construct of Bandura's Social Cognitive Theory, has been integrated into various behavior change theories (Biddle & Fuchs, 2009). It is defined as the situation specific confidence in one's ability to perform a task, and is one of the strongest predictors of behavior (Trost et al., 2002). The development of SE occurs through the integration of four main determinants: 1) mastery experiences (experiences gained from past performances), 2) vicarious experiences (observation of another individual with similar

characteristics), 3) social persuasion (encouragement and feedback from others), and 4) physiological and affective responses (i.e. changes in heart rate or emotional responses to external variables). Past experience has been identified as the strongest source of SE (Trost et al., 2002). This motivational construct plays a significant role on daily choices and actions of people and has been shown to be one of the primary predictors of weight loss success in behavioral interventions (Teixeira et al, 2010).

The integration of SE into the TTM has been used to help explain temptation and the facilitation of change in multiple weight control behaviors. Self-efficacy influences an individuals goal level, commitment to a task, choice of what task to partake in, interpretation of feedback, and affective reactions to tasks, and is also considered as a cognitive process involved in self-regulation (Gist & Mitchell, 1992). The ability to self-regulate or control a perceived threat or barrier has lead to multiple studies looking at the role of SE on overcoming barriers and the integration of SE determinants. (Bray et al., 2001).

Bandura characterizes individuals with high SE as more likely to pursue more challenging tasks and persist through failure, while people with a low SE may have lower motivation and see failures as a part of their own shortcomings (Bandura 2006). The integration of SE determinants is essential to the outcome and influence of intentions on behavior. An individual's integration of SE sources is more closely related to behavioral outcomes (Bandura 2010). For individuals who are not motivated to start, small tasks are most important for building SE.

Barrier SE for activity assesses typical barriers leading to inactivity (i.e. not enough time, weather, fatigue). These scales are often used to predict future maintenance of programs and exercise adherence (Basen-Enquist et al., 2010). As an important component of

weight loss interventions, small realistic goals are key for developing SE and leading to long term outcomes. A number of approaches have been used for assessing diet and physical activity SE and these are summarized in the sections below.

Weight Control Self-Efficacy (Diet and Activity)

Diet Self-Efficacy

The development and validation of eating SE scales have been well characterized. This component was investigated in a study in 1986 (Glynn and Ruderman) that found two reliable factors: concern with eating patterns when experiencing negative effect of stimulus (anxiety or stress) and eating under circumstances found socially acceptable. Individuals who were classified as dieters reported higher difficulty controlling eating. Another eating SE scale was developed to capture an individual's ability to resist the desire to eat under certain circumstances (Clark et al., 1991). The dietary component of weight control and weight loss is important but exercise is also critical. A recent study demonstrated that diet SE was related to exercise SE (Andrade et al., 2010). The interaction and integration of these two components in weight loss interventions is an important component to an individual's success.

Physical Activity and Exercise Self-Efficacy

Exercise SE has been suggested as a good predictor of exercise behavior and maintenance, but many studies have found that exercise SE is only predictive of behavior during the beginning of an intervention or in "active treatment" when individuals are influenced by other factors such as social support, education, and guidance (Linde et al., 2006; McAuley et al., 1994). McAuley et al. (1994) used a randomized control design to

examine the influence of SE determinants on the adherence of exercise in sedentary middle-aged males and females. Participants were randomized to either a SE enhanced exercise group (utilizing the four determinants of SE) or control group with similar exercise patterns and equal attention. Individuals in the SE intervention group reported increased exercise frequency, duration, and distance walked from baseline to completion of the program. Self-efficacy was a predictor of exercise behavior at the beginning and middle of the program, but not in the last month.

Weight Control Decisional Balance

Behavioral change can take years to initiate and even longer to become habit. The process of changing a habit starts with the contemplation to change followed by the initiation of changing the behavior, which is commonly assessed through measures of decisional balance. Decisional balance (DB) is a core construct of the TTM used to explain individual's motivation by assessing their perception of benefits and barriers to a behavior. The DB scale was first developed by Mann and colleagues (Janis and Mann, 1977) and later integrated into the TTM when applied to smoking cessation programs (Velicer et al., 1985). The weight control decisional balance scale attempts to identify primary reasons for engaging in weight loss behaviors and the Pros and Cons. Individuals who have more Pros to a behavior are most likely in a stage of action or preparing to make changes, whereas those who have Cons that outweigh Pros are not likely acknowledging the need or desire to make any changes. Decisional Balance scales have been associated with categorizing individuals into different stages of change based on the TTM (Marcus et al 1992).

Decisional balance has also been used with SE to examine weight loss outcomes in weight management programs. In a study by Pinto et al (1999), a 12-week weight management intervention was provided to 32 obese women. The intervention resulted in significant improvements in SE for both eating and exercise, but not significant changes in DB. The study supports evidence that SE for diet and exercise changes quickly after success in weight management programs and emphasizes helping participants identify skills within a program that helped them facilitate weight loss. The findings suggested that DB may not change as much when individuals are in action, while if participants are maintaining a habit, there is a clear differentiation of pros to a behavior. It is assumed that individuals in an action stage have higher levels of both SE and DB.

Weight Control Processes of Change

Once a decision is made to change a behavior, multiple processes can be applied to help facilitate successful behavior change. The TTM attempts to explain this movement through stages using cognitive and behavioral processes of change. Cognitive processes are generally used early on in interventions or with people who need to identify the need to make a change, whereas behavioral processes are more effective in stages where individuals have started to take some action. All of the processes are amplified and facilitated through the use of self-monitoring, which is the key in behavior change programs. The integration and application of self-monitoring acts as the primary facilitator for the individual to identify what processes need to be applied in order to change a problem behavior.

While commonly used in planning interventions, processes of change are one of the least studied constructs of the TTM (Horwath 1999). Prochaska identified 12 distinct

processes (five cognitive and seven behavioral) that may be particularly relevant for explaining how a person adopts weight control behaviors (Prochaska et al 1992). The five cognitive processes are named 1) consciousness raising 2) dramatic relief, 3) environmental reevaluation 4) social liberation 5) self reevaluation and the seven behavioral processes are named 1) helping relationships, 2) reinforcement management, 3) self liberation, 4) counterconditioning, 5) stimulus control 6) substance use, and 7) interpersonal systems control. Further descriptions of processes of change related to the specific interventions are provided in Appendix A.

Previous research assessing POC used for diet and exercise changes have shown counterconditioning, stimulus control, and self-liberation to be to be the primary behavioral processes used for increasing fruit and vegetable intake (Chung et al., 2006) Another study assessing POC in a worksite weight control program found increases in counterconditioning, contingency management, stimulus control, interpersonal control, and social liberation (Prochaska et al., 1992). The behavioral weight loss program included a series of 10 sessions focusing on nutrition and exercise, self-monitoring, stimulus control, goal setting, cognitive restructuring, contingency management, social support and weight loss, which would help explain some of the improvements in specific behavioral POC.

Little research has been done applying the POC to weight control programs. One of the reasons POC have not been examined is due to the difficulty in measuring certain processes and differentiating how to assess change (Horwath 1999). There are however, some key components of behavioral therapy that have been measured and found to help improve weight loss outcomes and lead to behavior changes. These include self-monitoring and motivational interviewing, which combined may be powerful methods to help increase

SE for challenging behaviors and lead to behavior change. Current components of successful weight loss programs are discussed further.

Components of Effective Behaviorally-Based Weight Loss Programs

There is considerable interest in determining factors associated with effective behavioral weight loss programs. The American Dietetic Association (ADA) recommends a multiple behavior strategy approach that includes the use of self-monitoring, stress management, stimulus control, problem solving, contingency management, cognitive restructuring, and social support. Research has consistently shown that a multidimensional approach to weight loss is more successful than focusing on only one variable (Foreyt and Goodrick 1993). Among these strategies, self-monitoring of diet and physical activity have been identified as the most important factor for successful weight loss, and motivational interviewing has recently become identified as a potential facilitator of initiating and maintaining skills associated with weight loss and maintenance.

The guided weight loss program (GWLP) used in the current study is an example of a behaviorally based program that meets ADA programming recommendations [1]. This program adopts a health coach model and motivational interviewing techniques to help facilitate behavior change. The primary goal of the program is to help teach lifelong weight control skills through the development of a healthy relationship with food and an active lifestyle. The program used the incorporation of goal setting, weekly face-to-face meetings with a health coach, and individualized educational meetings to improve participant's awareness on topics including nutrition fact panel reading, portion sizes, mindful eating, food cues, social

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[1] The BonSante Guided Weight Loss Program weight loss program was developed by a registered dietician in St. Louis (Kathy Thames) and is being used (by permission) at Iowa State through a collaborative research partnership.

support, and re-evaluation of progress and goals to educate the participant and provide

support and feedback during weight loss.

Active weight loss was the primary focus of the GWLP due to the relatively short

intervention length. The use of meal replacements or calorie-controlled portions was used

during the to help eliminate decisional burden about choosing foods. This has been shown to

help individuals lose weight during the initial weeks of the program (Heymsfield et al., 2003,

Berkowitz et al., 2011). As participants progressed and become more confident, the emphasis

shifted to consuming whole foods in place of meal replacements as new skills were

introduced to help build confidence. The GWLP relied on self-monitoring and motivational

interviewing techniques to promote individual problem solving. Additional detail is provided

on the importance of each for weight loss programming.

Self-Monitoring

Self-monitoring is considered to be the one of the most salient behavioral skills for

behavior change (Foreyt and Goodrick 1993). It is included in the category of self-regulation,

which is critical for success in any behavior change. The use of self-monitoring in behavior

interventions causes the participant to become aware of problem behaviors by recording

personal behaviors. Advances in technology and utilization of the Internet has allowed for

new innovative tools to be used for self-monitoring. Common self-monitoring tools include

paper and pencil methods of reporting diet and exercise behavior, the use of pedometers to

track number of steps, and more recently the SenseWear Pro Mini-Fly armband (SWA) and

associated FIT Weight Management System (WMS).

The SWA is an advanced physical activity monitor that provides users with estimates of steps, accurate energy expenditure in healthy adults (Johannsen et al., 2010), and level of physical activity throughout the day. A watch interface enables participants to see moment-by-moment physical activity and caloric expenditure updates. In addition to direct feedback, the SWA stores data retrieved from daily activities and can be downloaded over time on a personal computer. The WMS is an internet-associated tracking tool that allows participants to integrate data from the SWA with a self-reported dietary record.

By integrating estimates of energy expenditure and energy intake it is possible for individuals to estimate energy balance on a daily basis. Polzien et al. (2007) used the SWA in combination with a short-term behavioral weight loss program to help track energy balance. Findings suggested that the continuous use of the monitor provided more successful results for weight loss verses intermittent use of the monitor. The group that wore the armband continuously in combination with the behavior program lost the most weight (Polzien et al. 2007). This study supports the need for more research to determine what individuals would benefit the most from technology interventions and if the armband alone is enough of a mediator for individuals not involved in a behavior program.

Another important component related to self-monitoring is goal setting. The relationship between the two is critical for successful weight loss and weight control. A continuum for goal setting created by Shilts et al (2004) identified self-assessment as the first step of goal setting, which leads to a commitment to the specific goal. Specific, Measureable, Attainable, Realistic, and Timely (SMART) goals are developed to help participants increase self- efficacy through reaching these goals and developing new goals. This method of goal setting is similar to components reviewed by Locke et al (1981) for workplace settings using

proximal, specific, difficult and attainable goals. Tracking and feedback on diet and physical activity in alignment with goal modifications helps lead to SE for the specific goal (Strecher et al 1995). The use of motivational interviewing with self-monitoring may lead to more realistic goals and improved SE (Levy et al 2007). In addition, the use of the SWA may help increase SE for performing activities and maintaining a healthy diet by providing accurate information to individuals on behaviors. This device may help individuals form more realistic goals for changing behaviors leading to more success and increased confidence.

Motivational Interviewing

Motivational interviewing (MI) is a client-centered approach that helps facilitate problem solving and increase SE through empathetic listening and guidance. It was originally developed by Miller and Rollnick for individuals with drinking problems (DiLillo, Siegfried and West 2003). The use of motivational interviewing in behavioral obesity treatment has been shown effective in facilitating behavior change (DiLillo Siegfried, West 2003) and has been used in combination with multiple theories including the TTM suggesting promising interventions for self care (Paradis et al., 2010).

Motivational interviewing follows five principles: 1. Expressing empathy, 2. Developing discrepancies, 3. Avoiding argumentation, 4. Rolling with resistance, and 5. Supporting SE (Shinitzky and Kub 2001). It is important for a patient to trust their health care provider and develop an open relationship so challenges can be discussed openly in order to identify where there is resistance in changing a behavior. The role of the health coach is to develop that relationship through these principles to help facilitate change in the

individual and help the patient take control of his/her life. These principles help the

practitioner and patient work together to make decisions and change behaviors.

Motivational interviewing may be most beneficial for individuals at the initiation of

weight change programs due to the high level of ambivalence. Motivational interviewing has

also been shown to help improve adherence, which results in more successful interventions

(Smith et al., 1997). This may be especially important in weight loss interventions due to

ambivalence and necessary self-awareness and problem solving involved in addressing

problem behaviors. It also provides accountability for the individual. The role of MI can help

as a facilitator with patients by helping individuals set realistic goals to improve SE and

improve self-control. The client is considered the expert of him or herself, so MI takes more

pressure off of the provider and focuses attention on the individual and ways to help them

identify successful methods of change. This is obtained primarily through empathetic

listening or client-centered counseling skills, reflective listening, rolling with resistance and

helping the individual identify situations he or she can control. Motivational interviewing in

obesity treatment can help the individual focus on setting specific goals to help reduce stress,

develop better communication, or positive self-talk, which may influence their eating and

activity behaviors. When clients are able to set more realistic goals they are able to improve

their SE.

One of the main goals of MI is to help improve SE for behaviors through the

development of discrepancies between goals (Miller and Rollnick, 1991). This allows the

individuals to discuss and talk to the interviewer about the benefits and barriers of changing a

behavior, allowing them to processes more fully what his/her biggest challenges are through

verbalization. The individual may perceive a barrier to be too large, but when broken down it

more realistic and attainable. The health coach builds rapport with the individual during the first session through engaging the participant with questions and discussing the clients past health history. This creates a trusting relationship, which allows the participant to open up about difficult problems or challenging situations. Asking questions is able to help the person engage in evaluating their behavior and help change decisional balance by identifying and outweighing the positive to negative aspects of change (Prochaska et al., 1992, Weinstein, 1988).

To advance research on obesity prevention and the adoption of healthy lifestyles it is important to measure behavioral processes that may influence or mediate behavior change. Identifying specific behaviors that are associated with greater weight loss results may allow interventions to be specifically adapted to different individuals based on baseline assessment of the readiness to change by the individual. This study uses the TTM constructs to examine behavioral processes.

Summary

The importance of assessing motivational factors associated with behavior change for weight control is important for developing successful interventions. This review provided an overview of the research that has been done assessing key constructs of the TTM, specifically SE for weight control behaviors (diet and physical activity), DB, and POC. Changes in these constructs will be measured in each intervention program to help explain how self-monitoring, using SWA and WMS technology, and how MI techniques influence weight loss outcomes and psychosocial factors related to weight control.

CHAPTER 3. METHODS

The study was conducted as part of a broader evaluation of a randomized clinical trial evaluating different weight loss programs. Changes in clinical measures have been reported in a separate document so the focus in this study is on the TTM constructs of behavior change. This chapter describes the overall design, measures used to evaluate behavioral outcomes, and the procedures used to collect, process, and analyze the data.

Participants

One hundred and eight participants were recruited through the Nutrition and Wellness Research Center (NWRC) to participate in an 8-week randomized clinical weight loss trial. Seventy-eight participants (32 males and 46 females) completed the interventions (See Figure 1. Participant Flow Chart). Participants were recruited in the fall (cohort 1) and spring (cohort 2) from Iowa State University in Ames and surrounding communities. Participants were recruited through campus mailings and word of mouth. Non-smoking adults ≥ 18 years of age with body mass index (BMI) ≥ 30 kg/m^2 were included in this study. Participants were excluded if they were pregnant, lactating or planning to become pregnant, diabetic (fasting glucose > 126mg/dl), fasting triglycerides > 500mg/dl, blood pressure > 160 mm Hg systolic and/or > 100 mm Hg diastolic pressure, anorexic or bulimic, or if they have had bariatric surgery, a heart attack or angina, recent or recurrent strokes, cancer, thrombophlebitis, severe liver, kidney or peptic ulcer disease, or chronic use of corticosteroids, or lost more than 10 lbs within the past 3 months. Participants were disqualified if they chose to participate or were currently participating in any other weight loss programs or studies. All participants had approval from their primary care physician to enter a weight loss program and signed an

informed consent form before beginning the study. The Iowa State University Institutional Review Board approved all measures.

Study Design

The study was designed as a randomized clinical trial to evaluate the relative effectiveness of three different 8-week weight loss programs. Participants signed an informed consent and completed a diet and medical history questionnaire to check for possible exclusion criteria. Eligible participants were randomized, using a computer-automated randomization sequence, to a health coach and one of three conditions: 1) Guided Weight Loss Program (GWLP), 2) SenseWear Armband with FIT Weight Management System (SWA), and 3) GWLP + SWA. The program started within the first week of randomization and behavioral surveys were administered to participants' pre and post intervention. These assessed Transtheoretical Model (TTM) constructs of Stages of Change (SOC), Self-Efficacy for Diet (SED) and Physical Activity (SEA), Decisional Balance (DB), and Cognitive and Behavioral Processes of Change (C-POC and B-POC). See Figure 2 for a detailed timeline of intervention measurements.

Health Coach Model

Health coaches were responsible for delivering the intervention to each group. All health coaches completed a specific course in nutrition counseling (FSHN 466) that focused on intuitive eating and motivational interviewing techniques. In addition to the coursework, health coaches received a two-hour training session (focused on weight loss programming) from an experienced registered dietitian. This training focused on how to build rapport, address barriers to changing, and use motivational interviewing (MI) techniques to help

facilitate change. The MI techniques focused on empathetic listening and problem solving with participants to help create realistic goals related to diet, exercise, and behavior. Five of the health coaches were graduate students in either the Department of Kinesiology or Food Science Human Nutrition, while one was an undergraduate in Kinesiology with a minor in Nutritional Sciences.

Each participant met face-to-face with the health coach on a minimum of least four separate occasions, week 1, 2, 5 and 9 for the SWA only condition and a up to eight times in conditions with the guided weight loss program. Coaches and participants were required to have a minimum of one contact per week, via telephone, email communication, or in-person meetings. These communications were used to give participants encouragement, discuss progress, and address any concerns a participant may have had. Each week participants completed weekly surveys to assess any lifestyle changes that may have occurred (i.e. change in medications, illness, stress).

Health coaches met weekly with a registered dietitian and research staff to discuss any problems or issues with participants and to receive professional guidance. These meetings also allowed the health coaches to share experiences with each other and keep consist communication across groups. A difference in health coaching was primarily based on face-to face- contact and program content. Further details about the health coach's role in each condition are provided below.

Descriptions of Interventions

Group 1. Guided Weight Loss Program (GWLP)

The GWLP provided participants with a structured 8-week intervention. The participants received dietary advice, weekly skills (goal setting, food cues and social support, special event eating, fiber and food label reading, mindful eating, stress and weight loss, and sleep), and behavioral guidelines through an educational booklet and motivational interviewing techniques via health coach. The programming emphasized consumption of six smaller meals per day and the use of meal replacements (defined as any portion controlled meal/bar/shake/beverage/recipe with 12–20 grams of protein and 200–300 calories per serving) designed to help control caloric intake and portion size. Fruit and vegetable consumption, physical activity, and tracking of behavior changes were the main features. The intervention was individualized to the needs of the participant based the individual's physical activity, diet, and behavior goals. Participants were also asked to keep weekly paper trackers of their dietary intake and minutes of activity to facilitate weekly meetings. Each meeting with the health coach lasted approximately 30–60 minutes after the initial appointment.

Group 2: SWA and WMS Condition (SWA).

The SWA condition provided participants with access to the SenseWear armband monitor and instructions on how to use the associated WMS. The monitor was worn on the back of the right triceps. Participants were also given a wristwatch display that provided real-time estimates of calories expended, minutes of vigorous and moderate physical activity, and number of steps taken during the day. The display provided immediate feedback for participants about activity levels, and emphasis was placed on training participants to utilize

the integrated WMS system to track dietary intake. Participants were trained to download the monitor, enter dietary intake and view reports of energy balance, nutrition, physical activity, sleep duration, and sleep efficiency. All participants were encouraged to wear the armband throughout the entire 8-week study.

After completing the first week wearing the armband, participants met with their health coach to review baseline activity and diet information to create individual diet, physical activity, and behavior goals. These goals were revised either via e-mail or during the next face-to-face sessions during week 5 and week 9. Participants in this condition received public resources (i.e. mypyramid.gov) as references for healthy lifestyle changes but were not taught the behavioral skills covered in the GWLP. Health coaches were available to help with any questions associated with the WMS software.

Group 3. Guided Weight Loss Program and SWA/WMS Condition (GWLP + SWA)

Participants in the GWLP+ SWA condition received the GWLP materials, the SenseWear monitor, and WMS. The GWLP was delivered in the same way as Group 1 and individuals were trained on how to utilize the armband and WMS to monitor their activity level and daily energy expenditure and intake. All participants were encouraged to wear the armband throughout the entire 8-week study, with an emphasis on monitoring diet and physical activity during week 1, 4, and 7. The use of the online dietary records was utilized in this group.

Outcome Measures and Data Collection Procedures

Outcome data were collected using behavioral surveys assessing Stages of Change (SOC), Decisional Balance (DB); (pros-cons), Self-Efficacy for diet (SED) and activity

(SEA), and Cognitive and Behavioral Processes of change (C-POC and B-POC). The SOC, DB, and POC scales were all developed at the Cancer Prevention Research Center (CPRC, 1991) in Rhode Island under the guidance of one of the founders of the Transtheoretical Model, James O. Prochaska. Self-efficacy scales were created using Bandura's guidelines for developing self-efficacy scales (2006). These were used to assess barriers associated with eating a healthy diet and engaging in physical activity. Internal consistency for scales was calculated using Cronbach's alphas.

Weight Control Stages of Change

The short form Stages of Change survey is a quick five item scale that enables the evaluation of a stage an individual is at: precontemplation, contemplation, preparation, action, or maintenance. This was comprised of four-yes/no question responses indicating a person's past weight control activity. None of the participants were categorized in precontemplation due to voluntary participation in the study.

Self-Efficacy (Diet and Activity)

Two separate scales: self-efficacy for diet (SED) and self-efficacy for activity (SEA), were created using guidelines and examples set by Bandura (2006) and by Clark et al's (1991) Weight Efficacy Life-Style Questionnaire. These measures were used to rate the individual's confidence to maintain a healthy diet and physical activity during challenging situations (i.e. under stress, during travel, when sick). The scales included twelve items categorized by emotional and environmental factors that influence weight control behaviors. Each scale provided the same items with one directed at the individual's confidence to be physically active and the other directed at healthy eating during challenging emotional or

environmental situations. Responses were measured using an 11-point Likert-type scale ranging from 0 (*not confident at all*) to 10 (*very confident*).

Weight Control Decisional Balance

The Weight Control Decisional Balance (DB) scale is a 20-item instrument assessing the Pros and Cons of weight loss. The Decisional Balance Score was calculated as the differences between Pros and Cons (Pros – Cons). Participants responded to surveys using a 5-point Likert-type scale indicating the importance of the statements according to the person's decision to lose weight (1 = *not important at all*, 2 = *slightly important*, 3 = *moderately important*, 4 = *very important*, 5 = *extremely important*). Changes in Pros and Cons were evaluated to help explain DB.

Weight Control Processes of Change Scale

The Weight Control Processes of Change Scale (POC) is a 48-question instrument that measures 12 processes of change. The 12 processes include consciousness raising, counterconditioning, dramatic relieve, environmental reevaluation, helping relationships, interpersonal systems control, reinforcement management, self libration, self reevaluation, social liberation, stimulus control, and substance abuse. Participants responded to each of the questions using a five-point Likert-type scale rating how frequently each behavior has occurred over the previous month (1 = *never*, 2 = *Seldom*, 3 = *occasionally*, 4 = *often*, 5 = *repeatedly* [*always*]). The processes include two hierarchal constructs: cognitive and behavioral constructs (C-POC and B-POC). These higher-level processes were identified by Rossi et al. (1991) in relation to a community based weight loss program. It has been shown that individuals in earlier stages of change use more cognitive processes, while those in the

later part use more behavioral processes. Similar reinforcements of these behavioral processes are used in the GWLP and described in Appendix A.

Statistical Analyses

The primary aim of the study was to examine changes in psychosocial factors that may influence weight loss in the three different treatment groups. Therefore, the analyses focused on evaluating changes in behavioral constructs of the TTM (Change = Post – Pre); specifically self-efficacy, decisional balance, and processes of change. The secondary aim was to examine possible relationships between changes in psychosocial factors and weight loss outcomes. Because the study relied on surveys it was important to evaluate the psychometric properties of the scales. Internal reliability was calculated at pre- and post-intervention using Cronbach's Alpha for all TTM behavioral constructs. Descriptive statistics (mean and standard deviations) were used to characterize the sample population. Group and gender differences for changes in behavioral outcome measures were assessed using two-way (group by gender) analyses of variance (ANOVA). Two separate two-way (group by gender) ANOVAs were used to examine the impact of the programming on change: 1) in SE (One for SEA and one for SED) and 2) Processes of change (one for C-POC and B-POC). If the group effect was significant, follow up analyses using Tukey's post hoc comparisons were conducted to identify which groups yielded differential results. Effect sizes from pre- to post-measures were also computed to reveal the magnitude of the psychometric changes in each group. These were conducted by computing the difference between pre and post measures divided by the pooled standard deviation.

The second aim, to examine possible relationships between changes in psychosocial factors and weight loss outcomes, was assessed using Pearson-product moment correlations between psychosocial variables and weight change to identify possible relationships. Quartile splits for weight loss were used to categorize and compare weight loss with psychosocial factors to help explain any patterns. Additional measures of self-ratings (combination of responses from weekly surveys assessing motivation) and health coach ratings (assessments made by health coaches after each meeting assessing the participants motivation) were measured in relation to weight loss to help further explain adherence and psychosocial patterns with weight loss.

Third party researchers conducted exit interviews after completion of the program to obtain participant feedback about program components and questions related to motivation, barriers to success, and successful components of each intervention were summarized to provide some insight on program components (see Appendix B).

CHAPTER 4. RESULTS

Descriptive Statistics

Eighty-nine participants were randomized to one of the three intervention groups, and 78 (31 males and 47 females) completed the 8-week intervention (83.8% remained in GWLP, 89.7% remained in SWA, and 89.7% remained in GWLP + SWA). Stages of change were evaluated and the majority of participants were categorized in contemplation (28.21%), preparation (39.74%), and action (25.64%). The remaining participants were categorized in maintenance (6.41%). Participants were recruited and guided through the study in two cohorts: fall (cohort 1) and spring (cohort 2). The two cohorts were combined to represent a larger sample size. Characteristics from both cohorts are provided in Table 1. Values in the table represent mean $\pm$ standard deviation for age, education, race, marital status, and height. Weight changes are represented in Table 2 and discussed further in relation to behavioral changes. The majority of participants were Caucasian (94.9%); which was representative of the recruited community. Ages ranged from 18- 72 years of age, with the average age being 38 years. The mean age for men was 31, while females were 47 years old. All participants were classified as obese according to standard definitions (BMI $\geq$ 30 kg/m2).

Baseline Comparisons

A series of two-way ANOVAs (group by gender) were run to test for differences in baseline measures of height, weight, BMI, body fat, and age. No significant differences between groups were found for baseline anthropometric measures. An additional series of two-way ANOVAs were run to evaluate baseline differences in psychosocial variables

(perceived stress, knowledge/skills self-ratings (motivation), and health coach ratings). There were no significant group differences for all variables ($p > 0.05$).

Reliability and Validity of Behavioral Scales

Cronbach alpha coefficients were calculated for each outcome variable to test for internal reliability of the scales. Alpha values at pre- and post- assessments and sample question items are provided in Table 3. Self-efficacy scales for healthy eating and physical activity had the strongest internal reliability, ranging from 0.90 to 0.94. The Pro and Con scales for DB had alphas ranging from 0.87 to 0.89. The alpha reliability values of the various POC variables ranged from 0.59 to –0.93. Four POC measures had alpha reliability values less than 0.70 (reinforcement management, self liberation, counterconditioning, and interpersonal control systems), these were examined in more detail to determine if deletion of individual POC items (each POC had four scaled items) would improve the internal consistency. This was not the case so all items were retained in the calculation of the final outcome variables.

Aim 1: Change in Psychosocial Outcomes

The primary aim of the study was to evaluate changes (pre-post) in the various TTM motivational and behavioral constructs. Stages of change were assessed and significant changes were found in both males and females for transitions from preparation to action ($p > 0.001$). The majority of participants completed the interventions in action (84.62%), with 2.56% in preparation, while none were categorized to contemplation. Participants categorized into maintenance had not maintained for 6 months, so this was not reported. Assessments provided insight to the stages the majority of the sample was in. These stages were not

evaluated in relation to other constructs due to the short duration of the intervention (8-weeks).

Separate summaries are provided for the two SE scales for physical activity (SEA) and diet (SED), the DB components (Pro, Con) and the two main Cognitive POC and Behavioral POC. Effect sizes are reported to provide a more quantitative indicator of the pre-post change in each behavioral construct for each treatment group. Overall intervention effects were also computed by combining data across groups and these results are shown in Table 4.

Self-Efficacy (Diet and Physical Activity)

Two way ANOVAs were used to examine group and gender differences in the change in self-efficacy outcomes. No effects were found comparing gender, group, and group by gender for self-efficacy for diet (SED) or activity (SEA). However, when all groups were combined (see Table 4), there were significant changes over time in both SEA ($t = 3.37$, $p = 0.0012$) and SED ($t = 3.99$, $p < 0.001$). Plots of the changes in SEA and SED were created to determine the nature of the changes (see Figure 3). While not significant, the plots reveal a tendency for greater improvements (larger effects) in the GWLP and GWLP + SWA with weekly face-to face health coach meetings. Large effect sizes were seen from pre- to posttest in both SE measures for the GWLP (SEA: 0.81; SED: 1.08), and GWLP + SWA (SEA: 0.56; SED: 0.96) compared to small effect sizes in SWA condition (SEA: 0.19; SED: –0.27) (Table 5).

Weight Control Decisional Balance

Decisional balance (DB) was computed by taking the difference between Pros and Cons (Pro-Con). The two-way ANOVA for the DB scale yielded significant group differences, $F(5,72) = 3.13$, $p = 0.04$. A plot of the relationships (Figure 4) shows increases for the GWLP + SWA but slight decreases for GWLP and the SWA only condition. There were no significant gender main effects or group by gender interactions.

Pros and Cons were also assessed separately from the DB scale (Pro-Con) to examine the independent relationships explaining DB. There were non-significant gender effects ($p = 0.85$), group effects ($p = 0.71$), or gender by group interactions ($p = 0.24$) for the Pro scale. However, there was a significant decrease over time ($t = -2.00$, $p = 0.049$) in Pros (Table 4). With Cons, a significant group main effect was observed ($p = 0.01$), with the mean change being the largest in GWLP + SWA (–0.44) compared to GWLP (0.03) and SWA only (0.03). There were no significant gender effects ($p = 0.24$), group by gender interactions ($p = 0.30$) or changes over time ($p = 0.78$) for changes in Cons. The effect size for the group differences from pre to post for Pros and Cons were small, with the largest effect size being the change from pre to post in the GWLP + SWA group (–0.45) (Table 5).

Weight Control Processes of Change

Two separate two-way (group by gender) ANOVAs were used to examine the impact of the programming on changes in POC (one for C-POC and one for B-POC). The multivariate effect was significant for the C-POC, $F(5,71) = 2.66$, $p = 0.029$, and a significant group by gender interaction was noted, $F = 5.12$, $p = 0.0084$. This was discounted since it was attributed to a particularly large effect size for three males in the GWLP.

When data were collapsed by gender and group, non-significant changes were observed over time for the cognitive scale ($p = 0.20$). For B-POC, there were non-significant gender effects ($p = 0.12$), group effects ($p = 0.22$), and non-significant group by gender interactions ($p = 0.14$). However, there was a significant increase in B-POC over time ($t = 5.40$, $p < 0.001$) indicating greater use of B-POC at the end of the intervention. Significant differences in time were found in five B-POC (Table 4): counterconditioning ($t = 5.24$, $p \leq 0.001$), interpersonal systems control ($t = 2.92$, $p = 0.0047$), reinforcement management ($t = 7.13$, $p < 0.001$), self-liberation ($t = 4.59$, $p < 0.001$), and stimulus control ($t = 2.98$, $p = 0.004$). Closer examination of the differences revealed a tendency for larger pre and post changes for groups receiving the face-to-face health coaching. Large effect sizes were found in the GWLP group for counterconditioning (1.03), interpersonal systems control (0.79), reinforcement management (0.82), and self-liberation (0.81). A large effect size was also seen in GWLP + SWA for counterconditioning (0.78). The SWA only group showed a large effect size in reinforcement management (0.76; see Appendix C for all POC effect sizes).

Aim 2: Relationships Between Psychosocial Outcomes and Weight Loss Outcomes

The second aim of the study was to examine the relationships between psychosocial factors and weight loss. Participants lost an average of 4.2 kg during the study with the combined group (Group 3) losing the most weight (4.9 kg) and the SWA only group (Group 2) losing the least (3.7 kg); however, there were no significant weight loss differences between groups. Weight loss, change in BMI, and waist circumference for each group is represented in Table 2. A 3-way ANOVA (Cohort by Group by Gender) was performed to test for possible differences in weight loss or behavior change variables between cohorts. A

significant cohort effect was found for weight loss ($p = 0.044$) indicating that the mean weight loss was larger in cohort 2 (4.0 kg) than cohort 1 (3.4 kg). There were no significant 2 or 3 way interactions with the cohorts, which suggested that the cohort did not influence group or gender differences. The treatments seemed to yield similar patterns of effects in both cohorts so data from both cohorts were combined to streamline the analyses and increase statistical power.

Correlations were computed between changes in weight loss and changes in behavioral constructs (Table 6). Correlations were generally weak between changes in weight and changes in behavioral constructs factors; therefore, supplemental analyses were conducted to determine if other factors could explain differences in weight loss outcomes. Weight loss and psychosocial factors were categorized by quartiles and comparisons were made to identify any patterns. Patterns were seen between the three largest weight loss quartiles and self-efficacy (Figure 5 and 6). There was a plateau effect for the last three weight loss categories, but a clear increase from the smallest weight loss to the largest weight loss and improvements in both self-efficacy for diet and activity. All quartiles comparing weight loss with B-POC were relatively similar, but no patterns were seen between weight loss and C-POC quartiles (Appendix D and E).

The influence of perceived stress and previous knowledge/skills at baseline were also examined by dividing the overall sample into quartiles. No patterns were observed between weight loss quartiles and baseline stress and skill level. Similar analyses were conducted to examine the influence of self-reported confidence and support during the 8-week trial. Data were taken from weekly surveys that participants completed at the end of each week. A clear pattern was evident between average self-rating (average self-ratings on motivation, feelings,

confidence, support and perceived success in the program), and amount of weight loss, with

larger weight loss observed for more positive self-ratings (Figure 7). Similar patterns were

evident when weight loss outcomes were examined relative to quartiles for average health

coach ratings (Figure 7).

CHAPTER 5. DISCUSSION

The specific goal of the present study was to assess motivational and behavioral constructs associated with behavior change and weight loss outcomes using the Transtheoretical Model (TTM). The predominant behavioral change strategies in the interventions were self-monitoring and motivational interviewing (MI) techniques. Self-monitoring has consistently been shown to help facilitate behavior change by creating awareness of problem behaviors and increasing self-efficacy (SE) for weight control behaviors (Boutelle & Kirschenbaum, 1998; Linde et al., 2006). The use of MI in weight loss interventions has been shown to help reduce ambivalence and increase adherence to programs; resulting in greater weight loss outcomes (Smith et al., 1997; Carels et al., 2007). These two components together have been shown to improve SE, which is a major predictor of behavioral outcomes in the clinical setting (Linden et al, 2010), but the relative effectiveness of self-monitoring and MI techniques on psychosocial measures have not been directly determined. The specific use of the SWA for self-monitoring (with and without MI) has also not been previously studied.

The present study examined the changes in TTM behavioral constructs, specifically changes in a) SE for diet and physical activity, b) decisional balance (DB); (Pros-cons), and c) cognitive and behavioral processes of change (C-POC and B-POC) before and after the 8-week intervention. Results for each outcome are discussed further with relationship to weight change outcomes followed by a summary.

Changes in Psychosocial Outcomes

Changes in Diet and Activity Self Efficacy

It was hypothesized that participants in GWLP interventions (Group 1 and 3) would have greater changes in both diet and physical activity self-efficacy (SED & SEA) compared to participants in the SWA only condition. The results generally supported these hypotheses; as larger effect sizes for changes in both SEA and SED in the GWLP interventions (compared with SWA only) were found. This was not surprising; as many studies looking at SE have shown that significant changes can occur within the first weeks of program success (Linde et al., 2006, Clark et al., 1999).

The larger effect sizes observed for changes in SED for the interventions receiving the GWLP make sense considering the nature of the curriculum. The GWLP utilized multiple educational sessions that specifically targeted eating behaviors (i.e. mindful eating, nutrition label reading, social situations, food cues) with the facilitation of weekly face-to-face MI techniques from the health coach. This would ideally lead to an increased SE for maintaining a healthy diet under challenging circumstances and has been supported by a previous study by Roach et al (2003) finding greater improvements in weight loss as eating habits and SE improved.

Weekly face-to-face meetings and goal setting with the health coach also may have improved accountability with participants, which may have been more beneficial than only meeting four times in the SWA only group. It is unclear how often face-to-face meetings utilizing MI techniques should occur in treatments. Studies have shown utilization of MI during treatment through Internet and telephone applications (Webber, Tate, Quintillani,

2008; Shaikh et al., 2011) have been more successful than no MI. The use of MI techniques in weekly sessions may have improved participant's compliance to the intervention and developed a more trusting and open relationship with the health coach.

A study by Stotland and Zuroff (1990) measured SE for 1) adherence to a diet in different situations, 2) ability to perform certain diet behaviors, and 3) reaching diet goals. They found the goal based SE assessment was most beneficial for predicting weight change during the treatment. Self-efficacy measures that are more specific to intervention programs may help identify the impact of the program goals.

Participants were asked to set goals in the areas of diet, physical activity, and behavior. The correlations revealed significant relationships between SED and SEA at both the baseline measure and at completion of the study (Appendix F). Previous research suggests interplay between these two behaviors (Andrade et al., 2010). These findings also suggest that there may be relationships between these two SE measures.

Change in Pros, Cons, and Decisional Balance

It was hypothesized that the groups receiving the GWLP intervention would have greater improvements in decisional balance (DB) compared to the SWA only condition. Significant increases were observed for DB, but, surprisingly, this effect occurred despite decreases in reported Pros of change (the Cons decreased to a greater extent).

This negative change in Pros may have been due to a higher motivation at the initiation of the program. Because individuals were volunteering, they may have had initial perceptions for the weight loss program and weight loss goals that were altered during the intervention period. Also, the length of the intervention period and introduction of new

materials may have been overwhelming to participants. The TTM explains that DB is most important when ambivalence about starting a new behavior is present. It suggests progressive movement to increased Pros and decreased in Cons as an individual becomes more motivated, which was inconsistent in this study.

The highest Pros in this study were primarily related to making changes to improve health. These included 1) "*My health would improve if I lost weight*", 2) "*I would feel more energetic if I lost weight*", 3) "*I would be able to accomplish more if I carried fewer pounds*". These were consistent from baseline to completion of the program suggesting that improving health was the most important for participants and may have been a key motivational factor despite negative changes in Pros. The most commonly reported Cons for changing weight control habits included 1) "*I would not be able to eat some of my favorite foods if I were trying to lose weight*", 2) "*My dieting could make meal planning more difficult for my family or housemates*", 3) "*In order to lose weight I would be forced to eat less appetizing foods*". These suggest barriers of knowledge on how to prepare favorite foods and enjoy them or eliminating certain foods that are pleasurable. The two groups receiving the GWLP (Group 1 and 3) received a list of recipes (portion controlled examples of breakfast, lunch, and dinner) as a part of the program, which may have helped some participants identify recipes they enjoyed (benefit) and eliminated some decision-making challenges about what to eat (barrier).

Motivational interviewing techniques have been used for participants struggling with ambivalence to change (DiMarco et al. 2009). The use of MI techniques helps the participant examine discrepancies between Pros and Cons. The use of MI, by helping individuals identify and outweigh cons to weight change, may have been a facilitator for the GWLP +

SWA group explaining the decrease in Cons. This may have been related to different motivational levels of individuals and utilization of multiple strategies available to those in the combined group.

Another explanation may have been related to clinical measures. In the National Weight Loss Registry (1994), individuals reported a triggering event that initiated weight loss. The number one trigger for males and females was related to medical purposes. Individuals in the combined group may have had higher medical concerns initially and might have improved them resulting in the decrease in cons. Since all groups were similar at baseline, there were no biases for changes in Pros and Cons. Goal setting for clinical and anthropometric measurements may have been facilitators in helping participants engage in changing behaviors. Feedback from physicians using objective measures has been shown to help facilitate motivation (Emmons and Rollnick 2001).

Individuals involved in weight loss programs tend to outweigh Pros to Cons because they are facilitating a change in behavior and realize the benefits of changing the behavior outweigh the cons, therefore leading to action. In a study by Pinto et al. (1999) SE and DB for exercise habits were measured in obese women over a 12-week weight management program. Findings from the study supported a positive change in SE during successful weight loss, but did not show changes in DB and suggested that it may not change until an individual is in maintenance. In relation to TTM stages of change SE and DB are associated with later stages and increased motivation. In this study there were no significant changes in Pros, Cons, or DB, which partially support our findings.

Changes in Cognitive and Behavioral POC

It was hypothesized that participants in the GWLP interventions would show more significant change in behavioral POC (B-POC) compared to those in the SWA only intervention. This hypothesis was not supported, but results did show that specific B-POC increased significantly from baseline to completion of the program, with greater changes observed in the groups with the GWLP. No significant changes over time were shown for cognitive processes (C-POC), however there was a significant gender and group interaction for C-POC. This may have been due to unrepresented genders in each group. The GWLP intervention (Group 1) had three men in it and their scores were relatively high, for C-POC, which may have influenced the interaction between groups and gender. No significant changes occurred over time for C-POC supporting the results that the majority of participants were utilizing B-POC as a means of being in the intervention.

The five B-POC that changed over time included: counterconditioning, interpersonal control systems, reinforcement management, self-liberation, and stimulus control. To further explain these changes, effect sizes were compared and larger effects were observed in the GWLP only program. Self-regulatory strategies in this group included self-monitoring, goal setting, and social support; all of which were included in the GWLP interventions. Participants in the GWLP set goals for diet, physical activity, and behavior. The weekly revision of goals with the health coach may help to explain the greater magnitude of change in SE for diet and for both GWLP groups.

The significant changes in these processes support other research findings that have utilized these processes. The use of goal setting, self-monitoring, and support from health coaches may have been the primary facilitators of these changes. Each group was required to

set goals in three categories: diet, physical activity, and behavior. The goals were developed

using SMART technique, which emphasizes creating Specific, Measureable, Attainable,

Realistic, and Timely goals. These were assessed at each meeting with the health coach for

individuals in the GWLP interventions and during the first week, fifth week, and completion

of program with the SWA only group. As a part of the goal setting processes, participants in

the GWLP interventions were required to write out a reward if they met their goal

(reinforcement management). These were specifically chosen by the individual and could be

either extrinsic goals (i.e. purchasing new workout clothes) or they could be intrinsic (i.e.

feeling better or having more energy or satisfaction of reaching the goal). Goal setting has

been shown to be a critical component of weight loss interventions because it encourages

participants to place focus on a specific area vs. getting lost in the multiple approaches and

areas that could be changed (Shilts et al. 2004). The goals were revisited throughout the

programs and modified based on the individual's evaluation of whether the goal was met or

not.

The skills provided in the GWLP interventions also encouraged utilization of B-POC

based on homework associated with skills. Stimulus control was closely related to the food

cues skill, where individuals would identify a trigger or temptation either at work or at home

(i.e. bowl of candy in the office) and modify the environment to remove the stimulus. For

example, if a participant had a snack bowl in his office at home, he would remove it from the

office area, or replace it with a healthier snack.

Relationship Between Psychosocial Outcomes and Weight Loss

There were modest differences in behavioral change measures despite significant weight loss across each intervention. Weak correlations were found between behavioral measures and weight loss, which was similar to a brief report by Fontaine and Cheskin (1997) using the Weight Efficacy Lifestyle Questionnaire (WEL). In Fontaine and Cheskin's study, the WEL was compared to attendance and weight loss outcomes in a weight loss program. Attendance and weight loss were correlated, but weight loss did not correlate with weight loss outcomes, similar to this study. The WEL focused on an individual's confidence to resist challenging situations. Suggestions have been made that self-efficacy for weight control should focus on an individual's confidence to perform behaviors that lead to weight control versus resist behaviors.

Comparisons between weight loss quartiles and psychosocial measures clearly showed that the last three quartiles had higher self-efficacy for diet and activity perceptions in relation to weight loss. No apparent patterns were found for other psychosocial variables. In any intervention it is important to examine the impact of compliance with the protocol. Quartile splits from data analysis also revealed patterns between health coach ratings and self-ratings of individuals based on average weekly scores related to motivation, support, feelings, and progress with the intervention. Individuals with higher self-ratings and health coach ratings showed more successful weight loss across quartiles. There was a more dramatic change in weight related to both the health coach rating and self-rating in the 4th quartile. The health coach ratings consisted of an average rating of 0–2 (0 being non-compliant to intervention and 2 being fully compliant) over the 8-week intervention. Health coaches rated their participant after each session based on their motivation level,

commitment to goals, timeliness, and interest in succeeding. The self-ratings also suggested

better compliance and success with the program based on the individual's self-reports. Those

who had higher average self-rating scores showed greater weight loss outcomes.

It is important to note that the results of the study reflect changes observed at the end

of the intervention. Behavior changes cannot adequately be assessed until the follow-up

measures are obtained. Analyses of these data may reveal differences in retention of weight

loss across groups and this, in turn, may indicate skills or traits needed for weight

maintenance. The outcomes of weight loss and the improvements in SE demonstrate that the

intervention worked, but the changes may be due to the intensive weekly MI and

encouraging messages from health coach as well as by the use of the self-monitoring tool. A

study looking at SE of a weight management program showed increases in SE during the

program, but upon 4-month follow-ups, SE had not improved (Linde et al., 2006). This study

showed a relationship between eating and exercise self-efficacy beliefs and weight loss

behaviors, and predicted weight change during the intervention period. The study used

mediation models to help explain weight loss and found that weight control behaviors

improved self-efficacy for weight change. Continued research assessing a 4 month follow up

will be a helpful indicator of the success of the intervention and what skills and experiences

were most beneficial for participants.

Limitations

There are several key limitations to this study. This study lacked a diverse sample

making it less generalizable to the general population. Most participants were middle class

and well educated. The length of the study was also a major limitation as behavioral

treatment is usually administered with weekly meetings ranging from 16–26 weeks (Wadden and Butryn, 2003). Significant changes in weight and psychosocial variables were obtained in the 8-week program, but the maintenance of these changes cannot be concluded until follow up. Even then, research shows that behavior change is difficult to maintain. The TTM classifies a change must last 6 months before it can be considered relatively permanent.

The primary limitation of the study was the lack of actual measures of diet or physical activity behavior. Because there was no behavioral assessment, conclusions cannot be made about what behaviors influenced the weight loss the most for each group. Data obtained from the SWA monitor can provide some information about diet and physical activity behaviors of the participants in these groups but this wasn't analyzed in detail since it wasn't available for participants in the GWLP only group.

From these measures it is not possible to determine whether behavior really changed. We can conclude that individuals with the GWLP materials and weekly MI tended to have greater change in SE, decisional balance, and application of processes of change, which might be important for long-term weight maintenance. The follow up will help to explain if behaviors practiced during the intervention were maintained four months later.

Another limitation to the study may have been due to the changes in health coaches and the impact they had on the study. Three health coaches were used consistently in both cohorts, but the other three were different for each cohort. Those helping in both cohorts may have improved MI skills leading to better outcomes with participants in the programs, although there were no complaints about health coaches and each health coach received the same amount of training. Internal validity was lacking due to variation across health coach personalities and coaching experience. Future research should help create more standardized

practices. Self-efficacy may be indirectly related to weight loss as it may help improve the self-regulatory behaviors that contribute to weight loss. The insignificant relationship between SE and weight loss is still warranted to help explain possible benefits of improving SE for barriers related to weight control. Though a study by Linde et al. (2006) found that correlations between SE for eating and exercise were not strongly related to behaviors. They did find that self-efficacy helped predict weight change from baseline to week 8 and that SE influenced weight loss during active treatment. Monitoring, effort, and attendance were also related to greater weight loss.

In summary, this is the first study to evaluate psychosocial constructs of behavior change in an 8-week intervention utilizing the SWA alone and in combination with a GWLP. Significant changes in DB (pros-cons) occurred in the GWLP+SWA as a result of decreased cons during the program intervention. Despite non-significant differences between groups for SE and POC, effect sizes showed that changes in diet SE and behavioral POC were largest for the two groups receiving the GWLP. Psychosocial measures could not be directly related to weight loss outcomes, although self-ratings and health coach ratings do suggest that individuals with a more positive self-rating and health coach rating had larger weight loss outcomes. This study showed that the weekly face-to-face meetings with MI techniques, and self-monitoring in a GWLP alone and combined with SWA may help reduce the perception of barriers to changes in diet and physical activity more than either alone. Follow up analysis will be assessed to provide insight on the long-term effects of the intervention on behavioral constructs. Future research should assess changes in behavior during study interventions over longer periods of time to help explain weight loss and maintenance.

Conclusion

New techniques of self-monitoring and behavioral counseling offer promise for promoting behavior change for weight loss. However, little research has been done evaluating how the application of these techniques may influence behavior and motivation through assessments of psychosocial variables. More research needs to be done identifying motivational constructs that influence diet and activity behavior change; leading to a healthier lifestyle.

Findings from this study showed improvements in self-efficacy for the groups receiving the GWLP interventions, which may influence long-term attempts at weight control efforts. This study also suggests that behavioral processes of change may increase with weekly face-to-face health coaching and a structured weight loss program. These findings suggest the importance of a multidimensional approach to weight loss and provide insight on self-efficacy, decisional balance, and processes of change. Follow-up assessments are critical to assess if intervention components had lasting effects on behavioral processes and if improvements in self-efficacy were maintained over a 4-month follow-up period.

Table 1. Descriptive Characteristics of Participants

		Treatment Group		
Characteristic	All (*N* = 78)	GWLP (*N* = 26)	SWA (*N* = 26)	GWLP + SWA (*N* = 26)
Gender (n[%])				
Male	31 [39.74]	3 [11.54]	13 [50]	15 [57.70]
Female	47 [60.26]	23 [88.46]	13 {50]	11 [42.30]
Age (yrs)	38.61 ± 14.12	38.51 ± 19.50	38.61 ± 14.29	38.13 ± 13.04
Range	18–72	19–65	18–72	19–67
Education (n [%])				
High School/GED	1 [1.28]	0 [0.00]	1 [3.85]	0 [0]
Some college	17 [21.8]	7 [26.29]	5 [19.23]	5 [19.23]
2-year degree	6 [7.69]	0 [0.00]	2 [7.69]	4 [15.38]
4-year degree	31 [39.7]	10 [38.46]	9 [34.62]	12 [46.15]
Master degree	15 [19.2]	7 [26.92]	5 [19.23]	3 [11.54]
Doctoral degree	8 [10.3]	2 [7.69]	4 [15.38]	2 [7.69]
Race (n [%])				
Caucasian	74 [94.9]	25 [96.15]	25 [96.15]	24 [92.31]
African American	3 [3.84]	1 [3.85]	1 [3.85]	1 [3.85]
Asian	1 [1.28]	0 [0]	0 [0]	1 [3.85]
Marital Status (n [%])				
Single	34 [43.6]	10 [38.46]	12 [46.15]	12 [46.15]
Married	44 [56.4]	16 [61.54]	14 [53.85]	14 [53.85]
Height (cm)				
Male	181.0 ± 5.88	176.43 ± 4.97	181.92 ± 5.35	181.12 ± 6.38
Female	166.76 ± 5.73	166.56 ± 5.43	167.87 ± 6.56	165.86 ± 5.65
Weight (kg)				
Male	120.95 ± 19.29	112.70 ± 7.65	117.11 ± 17.70	125.93 ± 21.58
Female	102.61 ± 18.19	102.61 ± 15.96	106.61 ± 21.52	97.87 ± 18.98

Note. Values for height and weight are means ± standard deviations. GWLP: Guided Weight Loss Program; SWA: SenseWear Armband condition; GWLP + SWA: Combination condition.

Table 2. Change in Anthropometric Outcomes (Pre, Post)

Outcome	All (N = 78)	GWLP (N = 26)	SWA (N = 26)	GWLP + SWA (N = 26)
Weight (kg)				
Pre	109.90 ± 20.60	103.78 ± 15.48	111.86 ± 20.03	114.06 ± 24.59
Post	105.70 ± 19.98	100.08 ± 15.34	107.81 ± 19.29	109.18 ± 23.90
Change	–4.21 ± 3.08	–3.69 ± 3.14	–4.05 ± 2.87	–4.88 ± 3.21
BMI (kg/m^2)				
Pre	36.72 ± 5.48	36.80 ± 5.30	36.35 ± 5.27	37.00 ± 6.03
Post	35.33 ± 5.48	35.52 ± 5.46	35.04 ± 5.25	35.42 ± 5.92
Change	–1.39 ± 1.01	–1.28 ± 1.05	–1.30 ± 0.91	–1.58 ± 1.09
Waist (cm)				
Pre	120.08 ± 13.75	119.88 ± 13.91	120.55 ± 12.97	119.81 ± 14.85
Post	115.82 ± 14.02	116.31 ± 13.81	115.52 ± 13.96	115.61 ± 14.80
Change	–4.27 ± 3.58	–3.57 ± 3.82	–5.03 ± 3.37	–4.20 ± 3.54

Note. All values are means ± standard deviation. GWLP: Guided Weight Loss Program; SWA: SenseWear Armband condition; GWLP + SWA: Combination condition.

Table 3. Cronbach's Alpha Internal Reliability for Surveys and Survey Sample Items

Scale	Cronbach's alpha Pre	Post	Sample Item
Self-Efficacy			
SEA	.90	.94	How confident am I that I can be physically active when I am anxious
SED	.91	.94	How confident am I that I can eat a healthy diet when I am anxious
Decisional Balance			
Pros	.89	.89	My health would improve if I lost weight
Cons	.87	.88	Dieting would take the pleasure out of meals
Process of Change			
Consciousness Raising (CR)	.75	.79	I read about people who have successfully lost weight
Dramatic Relief (DR)	.83	.88	I react emotionally to warnings about gaining too much weight
Environmental Reevaluation (ER)	.85	.87	I consider the view that overeating can be harmful to the environment
Social Liberation (CL)	.59	.69	I am the object of discrimination because of my being overweight
Self Reevaluation (SR)	.79	.68	I get upset when I think about my overeating
Helping Relationships (HR)	.93	.92	I have someone who listens when I need to talk about my losing weight
Reinforcement Management (RM)	.60	.74	I reward myself when I do not overeat
Self Liberation (SL)	.63	.70	I tell myself I can choose to overeat or not
Counterconditioning (CC)	.59	.69	Instead of eating I engage in some physical activity
Stimulus Control (SC)	.80	.91	I remove things from my place of work that remind me of eating
Substance Use (SU)	.72	.83	I take some type of medication to help me control my weight
Interpersonal Systems Control (IS)	.68	.81	I relate less often to people who contribute to my overeating

Note. SEA: Self-efficacy for Activity; SED: Self-efficacy for Diet.

Table 4. Mean Changes in Behavioral Variables (Using Combined Data from All Groups)

Variable	Pre	Post	t value	p value
Self-Efficacy				
SEA	5.57 (1.55)	6.36 (1.61)	3.37	0.00
SED	5.82 (1.59)	7.04 (1.47)	3.99	0.00
Decisional Balance				
Pro	3.73 (0.78)	3.60 (0.74)	–2.00	0.05
Con	2.56 (0.80)	2.43 (0.76)	–0.29	0.78
Processes of Change				
CR	2.90 (0.70)	2.84 (0.78)	0.98	0.33
CC	2.64 (0.61)	3.09 (0.61)	5.24	0.00
DR	2.49 (0.81)	2.46 (0.85)	0.50	0.62
ER	1.57 (0.65)	1.68 (0.74)	1.47	0.15
HR	3.40 (1.19)	3.39 (1.04)	1.67	0.10
IS	1.67 (0.52)	1.88 (0.69)	2.92	0.00
RM	2.07 (0.66)	2.47 (0.73)	7.13	0.00
SL	3.54 (0.64)	3.85 (0.62)	4.59	0.00
SR	3.00 (0.89)	2.93 (0.79)	–0.90	0.37
CL	3.01 (0.85)	3.02 (0.90)	1.62	0.11
SC	1.78 (0.74)	2.16 (0.96)	2.98	0.00
SU	1.06 (0.20)	1.03 (0.09)	–0.48	0.63

Note. Standard deviation appears in parentheses after the mean, *t* values and *p* values indicate significant changes from Pre to Post significant at $p \leq 0.05$.

Table 5. Total Pretest and Posttest Means and Standard Deviations for Self-efficacy (SEA and SED), Pros, Cons in Each Group

	n	Pre		Post		
		M	*SD*	*M*	*SD*	*ES*
SEA						
GWLP	26	5.04	1.64	6.36	1.68	0.81
SWA	26	5.65	1.51	5.94	1.44	0.19
GWLP + SWA	26	6.03	1.38	6.80	1.65	0.56
SED						
GWLP	26	5.44	1.79	7.37	1.32	1.08
SWA	26	5.94	1.60	6.36	1.45	0.27
GWLP + SWA	26	6.09	1.34	7.37	1.46	0.96
Pro						
GWLP	26	3.95	0.71	3.88	0.73	–0.10
SWA	26	3.58	0.70	3.43	0.72	–0.21
GWLP + SWA	26	3.65	0.89	3.50	0.73	–0.17
Con						
GWLP	26	2.54	0.60	2.57	0.80	0.05
SWA	26	2.43	0.76	2.46	0.64	0.05
GWLP + SWA	26	2.71	0.98	2.27	0.82	–0.45

Table 6. Correlations of Changes in Behavioral Variables with Weight Changes

	Wt diff	SEA diff	SED diff	Pro diff	Con diff	ProCon diff	POC-C diff	POC-B diff
Wt diff	—	–0.1	–0.17	–0.02	0.12	–0.12	0.04	0.03
SEA diff		—	0.75*	–0.06	–0.01	–0.02	0.03	0.31
SED diff			—	0.02	–0.05	0.06	0.10	0.38
Pro diff				—	0.13	0.41	0.19	0.12
Con diff					—	–0.85*	0.17	–0.07
ProCon diff						—	–0.06	0.13
POC-C diff							—	0.32
POC-B diff								—

Note. Pearson Product correlations compared differences in behavioral constructs with weight differences and weak correlations were found. * = $p < 0.0001$.

Screened ($N = 109$)

Excluded ($n = 20$)
- Low BMI ($n = 10$)
- Withdrew ($n = 2$)
- Unable to draw blood ($n = 1$)
- No Show ($n = 3$)
- High glucose ($n = 2$)
- Smoker ($n = 1$)
- High blood pressure ($n = 1$)

Randomization ($n = 89$)

GWLP Condition ($n = 31$)

SWA Only Condition ($n = 29$)

GWLP + SWA Condition ($n = 29$)

Drop Out ($n = 5$)
- No response ($n = 1$)
- Not ready ($n = 3$)
- Surgery ($n = 1$)

Drop Out ($n = 3$)
- No response ($n = 3$)

Drop Out ($n = 3$)
- Armband problems ($n = 1$)
- Not ready ($n = 2$)

Analyzed ($n = 26$)

Analyzed ($n = 26$)

Analyzed ($n = 26$)
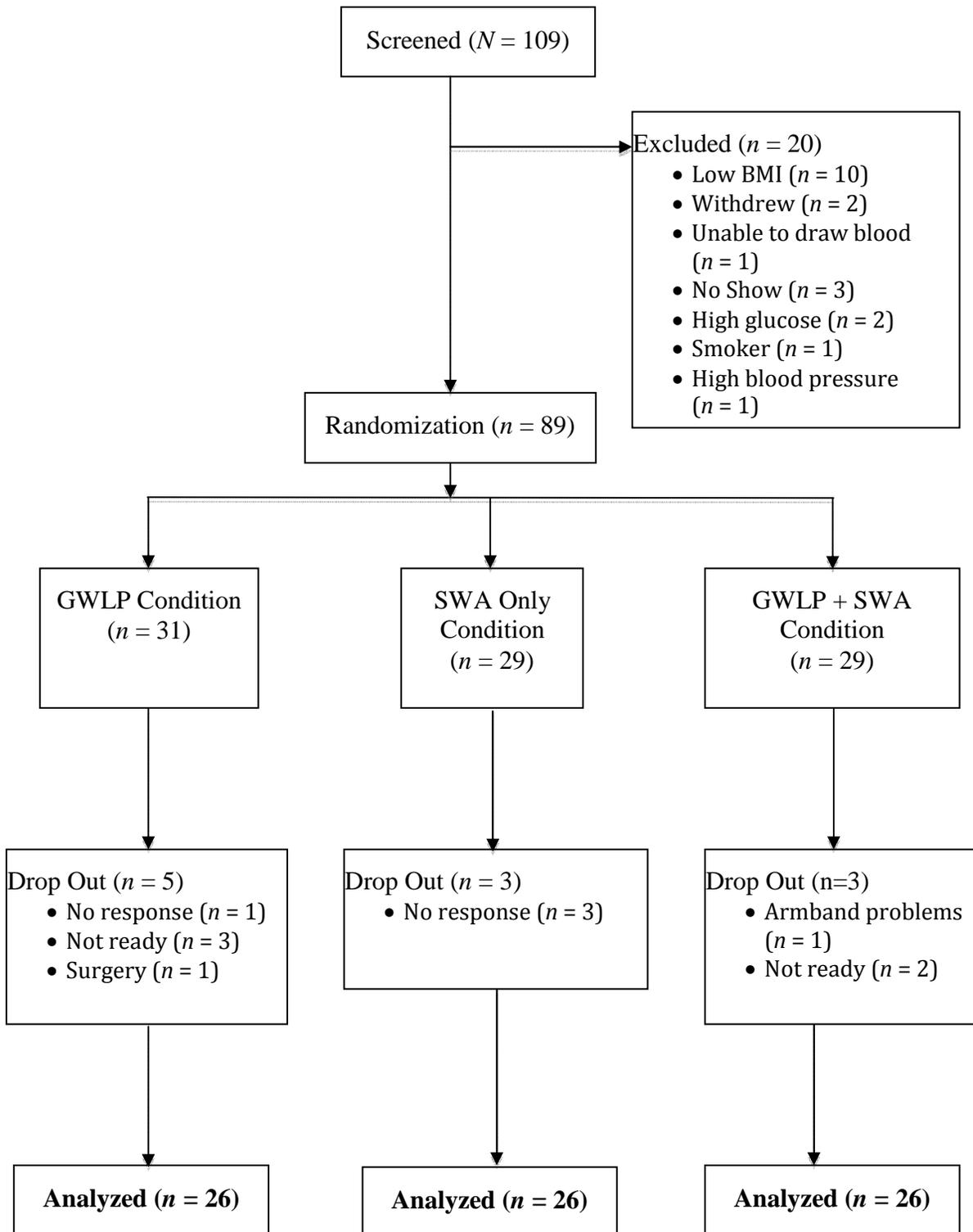
Figure 1. Participant Flow Chart.
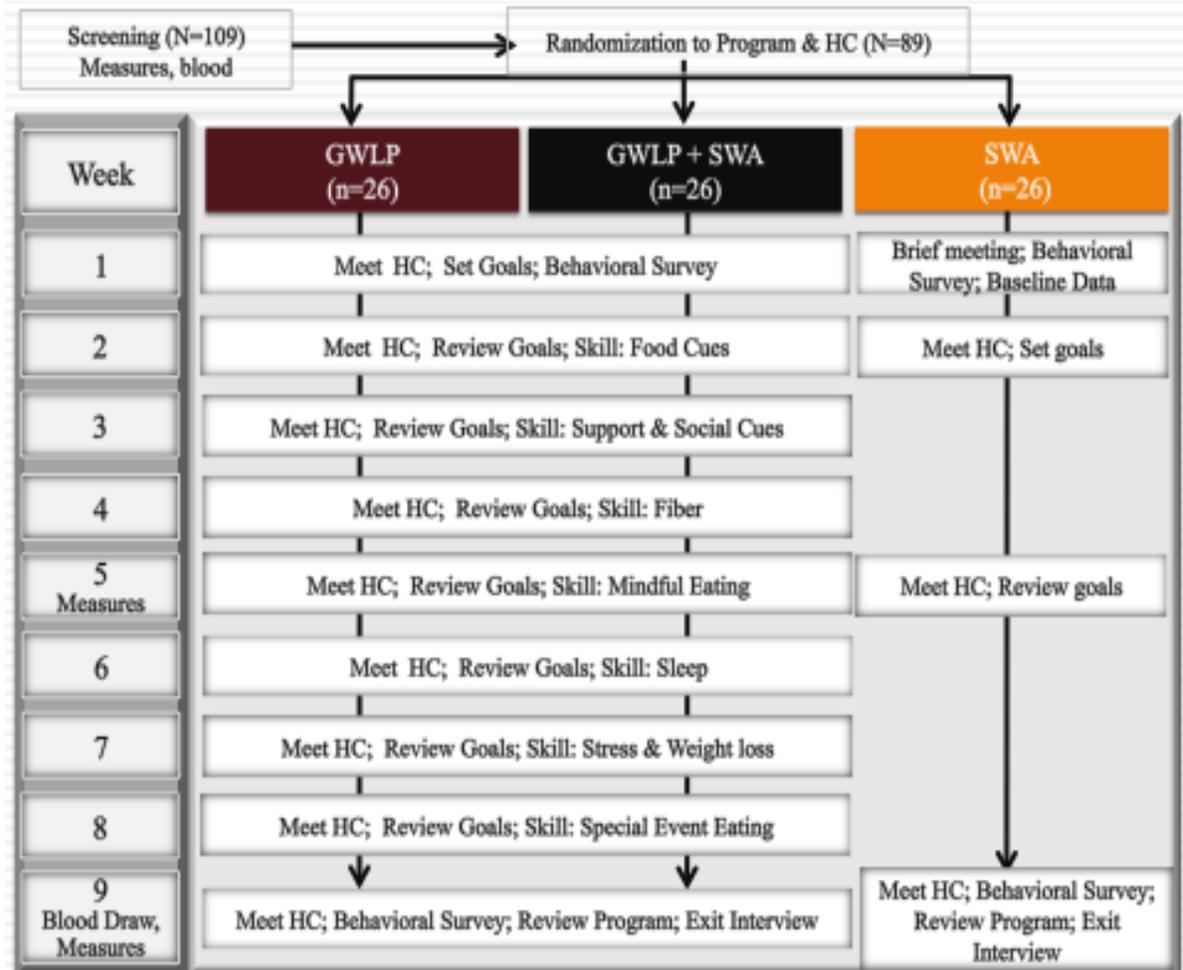
Figure 2. Timeline and Description of Interventions
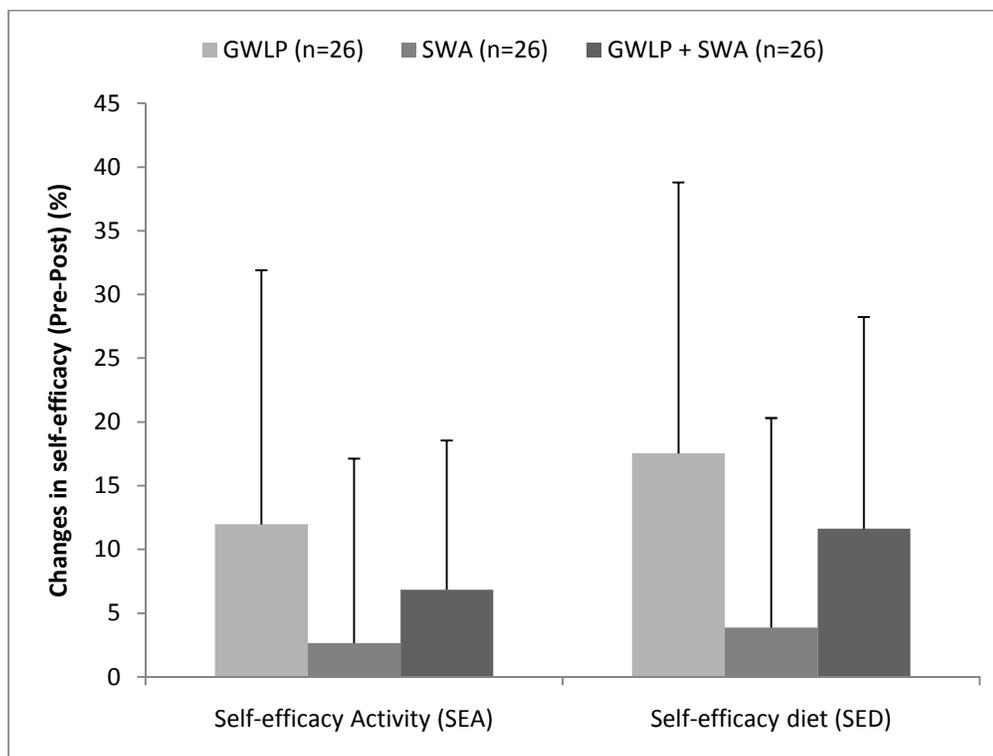
Figure 3. Percent changes in self-efficacy for activity (SEA) and diet (SED) between groups (*n* = 26) from pre to post intervention. Large variations are due to individual variations in each group and smaller sample sizes.
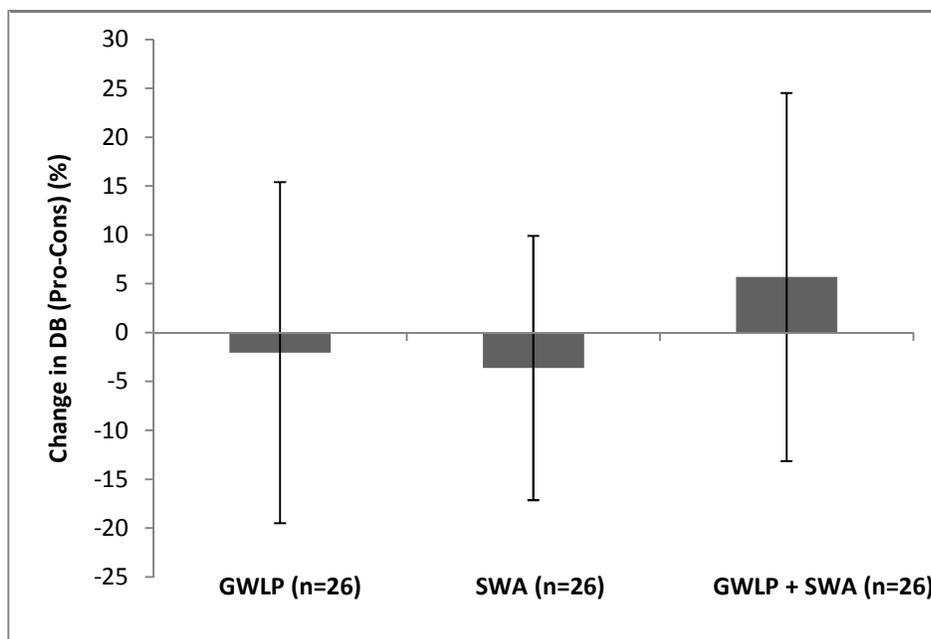
Figure 4. Percent changes in decisional balance (pro-con) between groups from pre- to post-intervention. The GWLP + SWA condition had significantly larger changes in decisional balance at $p < 0.05$.
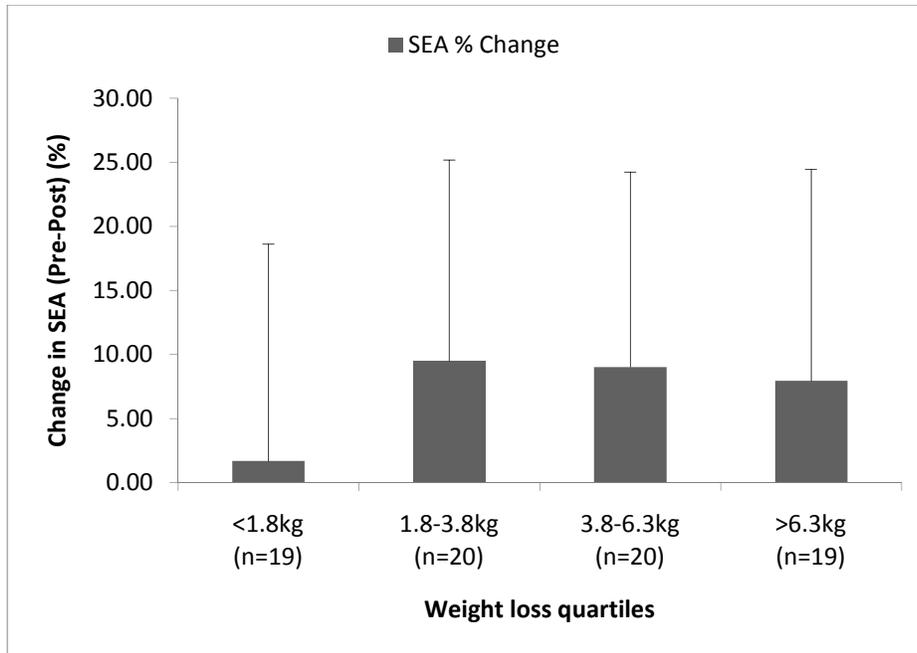
Figure 5. Changes in self-efficacy for activity (SEA) across weight loss quartiles. Percent change was calculated by taking the change in self-efficacy scores divided by the self-efficacy scale times 100.
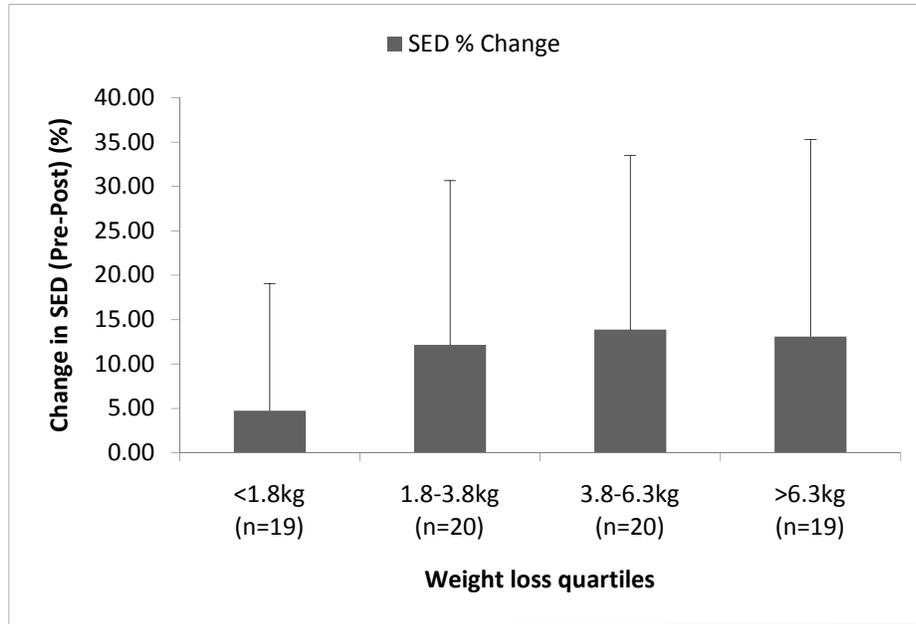
Figure 6. Changes in self-efficacy for diet (SED) across weight loss quartiles. Percent change was calculated by taking the change in self-efficacy scores divided by the self-efficacy scale times 100.
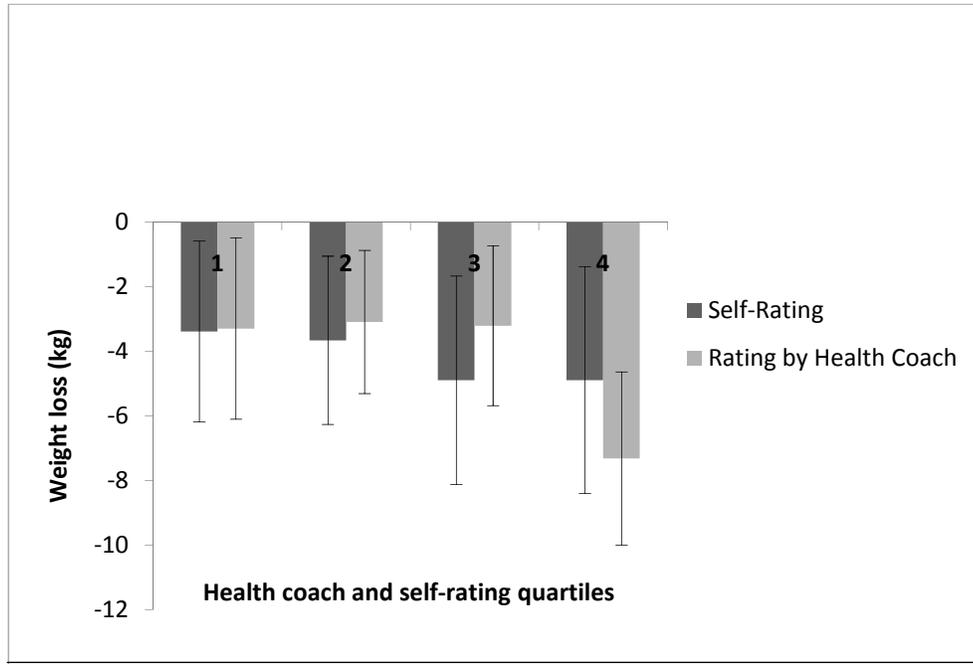
Figure 7. Quartiles for health coach rating and self-ratings related to weight loss (in kg). The first quartile represents the lowest scores for self-ratings and health coach rating, while the fourth represents the highest. Larger changes in weight loss were related to higher self-ratings and health coach rating. Frequencies for health coach quartiles included (1) $n = 21$, (2) $n = 18$, (3) $n = 20$, (4) $n = 19$). Self-rating quartile frequencies included (1) $n = 20$, (2) $n = 19$, (3) $n = 19$, (4) $n = 20$.

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APPENDIX A. DEFINITIONS AND REPRESENTATIVE INTERVENTIONS OF THE PROCESSES OF CHANGE

Process	Definition	Intervention GWLP Skills	SWA
Cognitive			
1. Consciousness Raising	Increasing personal awareness about diet and activity challenges and solutions	Educational material, self-monitoring (paper tracking)	Self-monitoring, educational materials from pamphlets (i.e. my pyramid)
2. Dramatic Relief	Experiencing and acknowledging concern about one's health problems and solutions	Clinical and anthropometric measures, health coaching sessions	Clinical and anthropometric measures, health coaching sessions
3. Environmental Re-evaluation	Assessing how one's diet and activity decisions may effect physical environment	N/A	N/A
4. Social Liberation	Increasing opportunities to eat healthier food and be more active in society	N/A	N/A
5. Self Reevaluation	Assessing the feelings and thoughts one has in relation to eating healthy and being active	Weekly, face-to-face discussions with health coaches	E-mails or discussions with health coaches
Behavioral			
6. Helping Relationships	Sharing problem behaviors or concerns with someone trustworthy and caring	Health coach	Health coach
7. Reinforcement Management	Receiving a reward for reaching a goal	Contingency contracts - accountability, goal setting rewards system	Goal setting rewards system every two weeks
8. Self Liberation	Making a commitment to act and believe in one's ability to change	Weekly goal setting with health coach	Goal setting
9. Counter-conditioning	Replacing problem behaviors with healthier alternatives	Stress management, positive self-statements, relaxation skills taught	N/A
10. Stimulus Control	Avoiding or replacing problem behaviors with positive stimuli	Food cues, physical activity cues, social situations skills	N/A
11. Substance Use/ Medication	Use of medication to alter appetite or metabolism	N/A	N/A
12. Interpersonal Systems Control	Avoiding tempting situations that lead to problem behavior	Social situation skill	N/A

APPENDIX B. SUMMARY OF EXIT INTERVIEW QUESTIONS

A third party researcher conducted exit interviews. Individual interviews were conducted on

all participants at the completion of the study to obtain feedback about the experience.

Questions assessed included the following:

1. What aspects of the program did you like?

2. What motivated you most during the program?

3. What do you feel were barriers to your success with weight loss?

4. What aspects/skills did you find most helpful?

5. What communication did you find most helpful with your health coach?

Responses to each question are summarized for each group:

1. Participants in the GWLP reported accountability with their health coach, tracking weekly food intake, following six small meals, and seeing progress as the most common helpful aspects of the program. Those participating in the SWA only and GWLP + SWA found the SWA and WMS to be the most positive aspect of the program based on the immediate feedback and objective information about their activity levels and dietary intake to identify energy balance. Those in the combined program also reported positive feedback about eating small meals and having a health coach.

2. Similar responses to primary motivators for weight loss were seen across all three interventions. These included seeing progress with weight loss and anthropometric measures and obtaining goals set throughout the program. Participants liked seeing changes in objective measurements and tracking progress. Accountability and meeting with the health coach was also indicated as an important motivator in both

GWLP intervention groups where participants met weekly with their health coach. Motivation from the armband seemed to come from increased self-awareness about diet and physical activity behaviors and a better understanding of what to modify to make healthier lifestyle changes.

3. Barriers for participants were similar in each group. These included stress, illnesses or injuries, trying to break old habits, portion control, and lack of confidence from previously failed weight loss attempts.

4. Skills that were found to be most beneficial in GWLP interventions included eating smaller meals, increasing protein and fiber intake, mindful eating, food cues, and information on portion control. Those in the two SWA intervention groups found the Weight Management System and armband tracking to be the most helpful skill used along with portion sizes, meal planning and exercise.

5. Every group reported that face-to-face contact was the most beneficial communication between him/herself and the health coach. Participants felt more accountable to the program and the health coaches when they had to meet face to face with them. Some individuals reported success with a combination of e-mail and face-to-face meetings with health coaches, but the consensus across most participants was that face-to-face contact resulted in better accountability to the health coach and the program. Statements about enjoying social interaction and seeing body language also helped participants.

APPENDIX C. PRETEST AND POSTTEST MEANS AND STANDARD DEVIATIONS FOR PROCESSES OF CHANGE

	n	Pre		Post		
		M	*SD*	*M*	*SD*	*ES*
CR						
GWLP	26	3.19	0.51	3.08	0.71	−0.23
SWA	26	2.68	0.84	2.54	0.81	−0.17
GWLP + SWA	26	2.83	0.74	2.89	0.82	0.09
CC						
GWLP	26	2.76	0.44	3.21	0.63	1.03
SWA	26	2.53	0.74	2.91	0.53	0.52
GWLP + SWA	26	2.63	0.65	3.13	0.68	0.78
DR						
GWLP	26	2.83	0.78	2.82	0.82	−0.01
SWA	26	2.20	0.83	2.02	0.72	−0.22
GWLP + SWA	26	2.45	0.82	2.54	0.99	0.11
ER						
GWLP	26	1.63	0.73	1.85	0.87	0.29
SWA	26	1.44	0.61	1.50	0.56	0.10
GWLP + SWA	26	1.64	0.62	1.68	0.79	0.07
HR						
GWLP	26	3.55	1.11	3.67	1.02	0.10
SWA	26	3.23	1.30	3.13	0.88	−0.08
GWLP + SWA	26	3.41	1.15	3.38	1.22	−0.02
IS						
GWLP	26	1.76	0.50	2.15	0.87	0.79
SWA	26	1.52	0.42	1.65	0.55	0.32
GWLP + SWA	26	1.72	0.64	1.83	0.66	0.17
RM						
GWLP	26	2.16	0.65	2.69	0.70	0.82
SWA	26	2.02	0.64	2.51	0.71	0.76
GWLP + SWA	26	2.02	0.69	2.20	0.79	0.26
SL						
GWLP	26	3.67	0.50	4.08	0.48	0.81
SWA	26	3.60	0.73	3.83	0.63	0.31
GWLP + SWA	26	3.35	0.70	3.65	0.73	0.43
SR						
GWLP	26	3.37	0.79	3.15	0.66	−0.28
SWA	26	2.97	0.93	2.93	0.80	−0.04
GWLP + SWA	26	2.66	0.97	2.71	0.91	0.06
CL						
GWLP	26	3.37	0.69	3.38	0.79	0.02
SWA	26	2.94	0.99	2.91	1.01	−0.03
GWLP + SWA	26	2.72	0.86	2.77	0.91	0.06
SC						
GWLP	26	1.88	0.79	2.42	1.18	0.68
SWA	26	1.73	0.61	1.93	0.71	0.33
GWLP + SWA	26	1.72	0.82	2.13	0.98	0.49
SU						
GWLP	26	1.05	0.20	1.00	0.00	−0.25
SWA	26	1.08	0.24	1.09	0.28	0.05
GWLP + SWA	26	1.04	0.15	1.00	0.00	−0.28

APPENDIX D. CHANGE IN B-POC COMPARED TO WEIGHT LOSS CATEGORIES
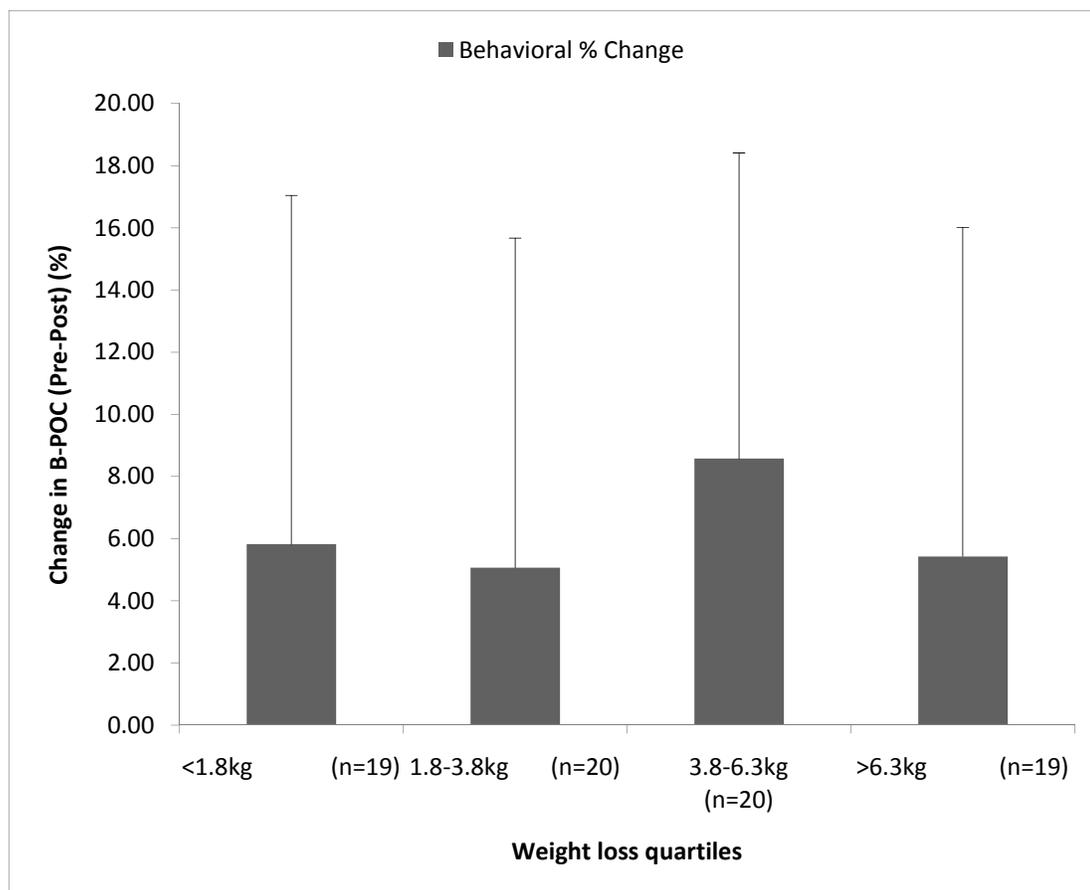
Note. Percent changes in behavioral processes of change (B-POC) across different weight loss quartiles. Each group improved B-POC. No significant differences were found.

APPENDIX E. CHANGE IN C-POC COMPARED TO WEIGHT LOSS CATEGORIES
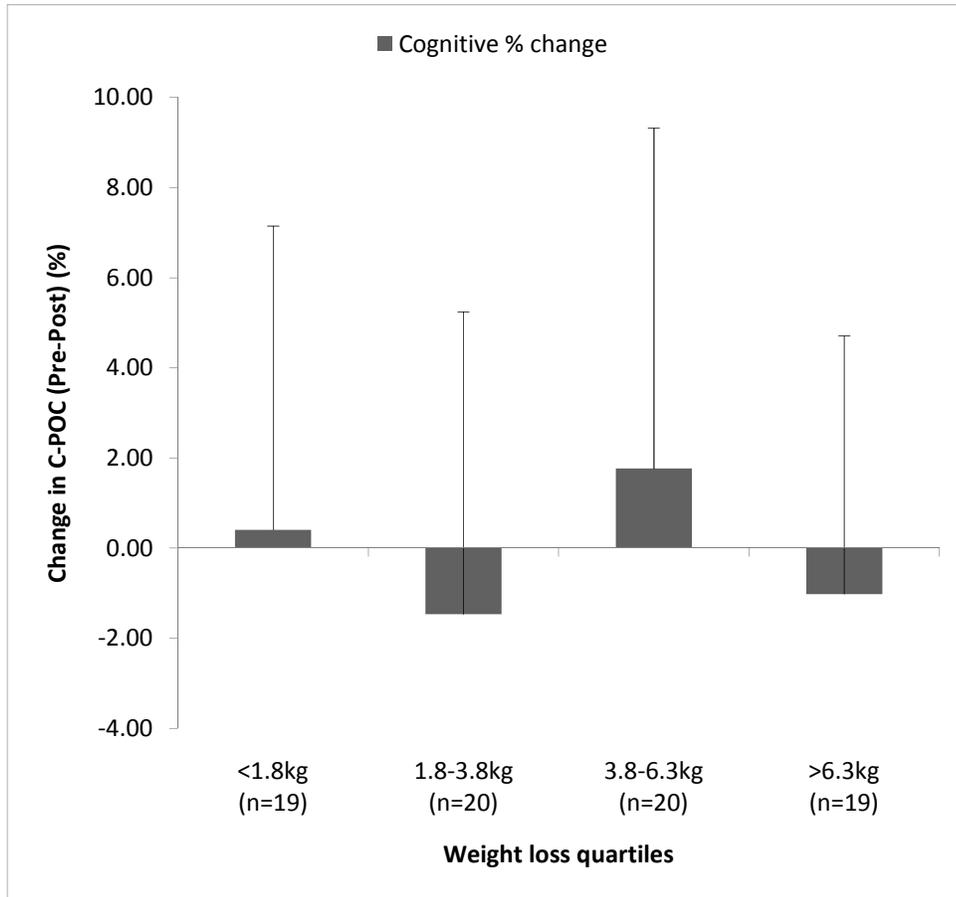
Note. Percent changes in cognitive processes of change (C-POC) across different weight loss categories. No patterns were recognized.

**APPENDIX F. PRE AND POST PEARSON CORRELATION
COEFFICIENTS FOR RELATIONSHIPS
BETWEEN BEHAVIORAL CONSTRUCTS**

	SEA	SED	Pro	Con	DB	POC-C	POC-B
			Pre				
SEA	—	0.68*	–0.23	–0.04	–0.14	–0.24	0.04
SED		—	–0.19	–0.17	–0.01	–0.16	0.10
Pro			—	0.20	0.62*	0.71*	0.38
Con				—	–0.64*	0.23	0.02
DB					—	0.37	0.29
POC-C						—	0.55*
			Post				
SEA	—	0.70*	–0.06	–0.37	0.27	–0.10	–0.07
SED		—	0.06	–0.28	0.29	0.03	0.06
Pro			—	0.33	0.57*	0.69*	0.53*
Con				—	–0.59*	0.24	0.14
DB					—	0.39	0.34
POC-C						—	0.72*

Note. * Significant at $p < 0.0001$

APPENDIX G. BEHAVIOR SURVEYS

Self-Efficacy for Diet (SED)

How Confident Are You That You Can Maintain A Healthy Diet?

Please provide honest answers. The knowledge provided from your responses will increase the understanding and development of programs that are designed to help people manage life situations with which they have to cope.
*12 items are listed below that may influence your choice to practice a **healthy diet.***
*Please rate your confidence that you can eat a **healthy diet on a regular basis** using the scale:*

0 = not confident to 10 = very confident

How confident am I that I can eat a healthy diet…	*Please circle your response*										
	Not confident					*Moderate*				*Very confident*	
when I am anxious (nervous)	0	1	2	3	4	5	6	7	8	9	10
during the winter	0	1	2	3	4	5	6	7	8	9	10
when I am angry (or irritable)	0	1	2	3	4	5	6	7	8	9	10
during holiday seasons	0	1	2	3	4	5	6	7	8	9	10
when I experience family problems	0	1	2	3	4	5	6	7	8	9	10
when I am tired	0	1	2	3	4	5	6	7	8	9	10
when I am depressed (or down)	0	1	2	3	4	5	6	7	8	9	10
when I am exceptionally busy	0	1	2	3	4	5	6	7	8	9	10
when I am travelling or on vacation	0	1	2	3	4	5	6	7	8	9	10
when I am stressed	0	1	2	3	4	5	6	7	8	9	10
when visitors are present	0	1	2	3	4	5	6	7	8	9	10
when I am recovering from illness or injury	0	1	2	3	4	5	6	7	8	9	10

Self-Efficacy for Physical Activity (SEA)
How Confident Are You That You Can Be Physically Active?

Please provide honest answers. The knowledge provided from your responses will increase the understanding and development of programs that are designed to help people manage life situations with which they have to cope.
*12 items are listed below that may influence your choice to **be physically active.***
*Please rate your confidence that you can be **physically active on a regular basis** using the scale:*
0 = not confident to 10 = very confident

How confident am I that I can be physically active	*Please circle your response*										
	Not confident				*Moderate*				*Very confident*		
when I am anxious (nervous)	0	1	2	3	4	5	6	7	8	9	10
during the winter	0	1	2	3	4	5	6	7	8	9	10
when I am angry (or irritable)	0	1	2	3	4	5	6	7	8	9	10
during holiday seasons	0	1	2	3	4	5	6	7	8	9	10
when I experience family problems	0	1	2	3	4	5	6	7	8	9	10
when I am tired	0	1	2	3	4	5	6	7	8	9	10
when I am depressed (or down)	0	1	2	3	4	5	6	7	8	9	10
when I am exceptionally busy	0	1	2	3	4	5	6	7	8	9	10
when I am travelling or on vacation	0	1	2	3	4	5	6	7	8	9	10
when I am stressed	0	1	2	3	4	5	6	7	8	9	10
when visitors are present	0	1	2	3	4	5	6	7	8	9	10
when I am recovering from illness or injury	0	1	2	3	4	5	6	7	8	9	10

Weight Processes of Change Survey

The following experiences can affect the weight of some people. Think of any similar experiences you may have in trying to lose weight or keep from gaining weight.

Please rate how FREQUENTLY you use each of these during the past month. There are FIVE possible responses to each of the questionnaire items.

Please check the box that best describes your experience.	Never	Seldom	Occasionally	Often	Repeatedly (Always)
I read about people who have successfully lost weight.	☐	☐	☐	☐	☐
Instead of eating I engage in some physical activity.	☐	☐	☐	☐	☐
Warnings about the health hazards of being overweight move me emotionally.	☐	☐	☐	☐	☐
I consider the belief that people who lose weight will help to improve the world.	☐	☐	☐	☐	☐
I can be open with at least one special person about my experience with overeating behavior.	☐	☐	☐	☐	☐
I leave places where people are eating a lot.	☐	☐	☐	☐	☐
I am rewarded by others when I lost weight.	☐	☐	☐	☐	☐
I tell myself I can choose to over-eat or not.	☐	☐	☐	☐	☐
My dependency on food makes me feel disappointed in myself.	☐	☐	☐	☐	☐
I am the object of discrimination because of my being overweight	☐	☐	☐	☐	☐
I remove things from my place of work that remind me of eating.	☐	☐	☐	☐	☐
I take some type of medication to help me control my weight.	☐	☐	☐	☐	☐
I think about information from articles or ads concerning the benefits of losing weight.	☐	☐	☐	☐	☐
I find that doing other things with my hands is a good substitute for eating.	☐	☐	☐	☐	☐
Dramatic portrayals of the problems of overweight people affect me emotionally.	☐	☐	☐	☐	☐
I stop to think that overeating is taking more than my share of the world's food supply.	☐	☐	☐	☐	☐
I have someone who listens when I need to talk about my losing weight.	☐	☐	☐	☐	☐
I change personal relationships which contribute to my overeating.	☐	☐	☐	☐	☐
I expect to be rewarded by others when I don't overeat.	☐	☐	☐	☐	☐
I tell myself that I am able to lose weight if I want to.	☐	☐	☐	☐	☐
I get upset when I think about my overeating.	☐	☐	☐	☐	☐
I notice that overweight people have a hard time buying attractive clothes.	☐	☐	☐	☐	☐
I keep things around my place of work that remind me not to eat.	☐	☐	☐	☐	☐

Please check the box that best describes your experience.	Never	Seldom	Occasionally	Often	Repeatedly (Always)
I use diet aids to help me lose weight.	☐	☐	☐	☐	☐
I think about information from articles and advertisements on how to lose weight.	☐	☐	☐	☐	☐
When I am tempted to eat, I think about something else.	☐	☐	☐	☐	☐
I react emotionally to warnings about gaining too much weight.	☐	☐	☐	☐	☐
I consider the view that overeating can be harmful to the environment.	☐	☐	☐	☐	☐
I have someone whom I can count on when I am having problems with overeating.	☐	☐	☐	☐	☐
I relate less often to people who contribute to my overeating.	☐	☐	☐	☐	☐
I reward myself when I do not overeat.	☐	☐	☐	☐	☐
I tell myself that if I try hard enough I can keep from overeating.	☐	☐	☐	☐	☐
I reasses the fact that being content with myself includes changing my overeating.	☐	☐	☐	☐	☐
I find society more supportive of thin people.	☐	☐	☐	☐	☐
I put things around my home that remind me not to overeat.	☐	☐	☐	☐	☐
I take drugs to help me control my weight.	☐	☐	☐	☐	☐
I recall information people have personally given me on how to lose weight.	☐	☐	☐	☐	☐
I do something else instead of eating when I need to relax or deal with tension.	☐	☐	☐	☐	☐
Remembering studies about illnesses caused by being overweight upsets me.	☐	☐	☐	☐	☐
I consider the idea that overeating could be harmful to world food supplies.	☐	☐	☐	☐	☐
I have someone who understands my problems with eating.	☐	☐	☐	☐	☐
I ask people not to overeat in my presence.	☐	☐	☐	☐	☐
Other people in my daily life try to make me feel good when I do not overeat.	☐	☐	☐	☐	☐
I make commitments to lose weight	☐	☐	☐	☐	☐
I struggle to alter my view of myself as an overweight person.	☐	☐	☐	☐	☐
I notice the world's poor are asserting their rights to a greater share of the food supplies.	☐	☐	☐	☐	☐
I remove things from my home that remind me of eating.	☐	☐	☐	☐	☐
I take diet pills to help me lose weight.	☐	☐	☐	☐	☐

Weight Decisional Balance Survey

Each statement represents a thought that might occur to a person who is deciding whether or not to lose weight. Please indicate how IMPORTANT each of these statements might be to you if you were considering a decision to lose weight. There are FIVE possible responses to each of the items that reflect your answer to the question "How important would this be to you?"

Please circle the number that best describes how important each statement would be to you if you were deciding whether or not to lose weight.	Not Important at all	Slightly Important	Moderately Important	Very Important	Extremely Important
The exercises needed for me to lose weight would be a drudgery.	☐	☐	☐	☐	☐
I would feel more optimistic if I lost weight.	☐	☐	☐	☐	☐
I would be less productive.	☐	☐	☐	☐	☐
I would feel sexier if I lost weight.	☐	☐	☐	☐	☐
In order to lose weight I would be forced to eat less appetizing foods.	☐	☐	☐	☐	☐
My self-respect would be greater if I lost weight.	☐	☐	☐	☐	☐
My dieting could make meal planning more difficult for my family or housemates.	☐	☐	☐	☐	☐
My family would be proud of me if I lost weight.	☐	☐	☐	☐	☐
I would not be able to eat some of my favorite foods if I were trying to lose weight.	☐	☐	☐	☐	☐
I would be less self-conscious if I lost weight.	☐	☐	☐	☐	☐
Dieting would take the pleasure out of meals.	☐	☐	☐	☐	☐
Others would have more respect for me if I lost weight.	☐	☐	☐	☐	☐
I would have to cut down on some of my favorite activities if I try to lose weight.	☐	☐	☐	☐	☐
I could wear more attractive clothing if I lost weight.	☐	☐	☐	☐	☐
I would have to avoid some of my favorite places if I were trying to lose weight.	☐	☐	☐	☐	☐
My health would improve if I lost weight.	☐	☐	☐	☐	☐
Trying to lose weight could end up being expensive when everything is taken into account.	☐	☐	☐	☐	☐
I would feel more energetic if I lost weight.	☐	☐	☐	☐	☐
I would have to cut down on my favorite snacks while I was dieting.	☐	☐	☐	☐	☐
I would be able to accomplish more if I carried fewer pounds.	☐	☐	☐	☐	☐

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