PILOT STUDY: EFFECT OF A WORKSITE WEIGHT-LOSS INTERVENTION AND SOCIAL INFLUENCE ON SELF-EFFICACY AND SELF-REGULATION FOR EATING AND EXERCISE

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DEDICATION

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ABSTRACT

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PILOT STUDY: EFFECT OF SOCIAL INFLUENCE AND WORKSITE WEIGHT-LOSS INTERVENTION ON SELF-EFFICACY AND SELF-REGULATION FOR EATING AND EXERCISE

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Employers need more effective workplace interventions to address overweight and obesity. Self-efficacy (SE) and self-regulation (SR) of weight management behaviors and social influence are important factors for weight loss. The purpose of this mixed methods study was to assess the influence of an intervention on SR, SE, and weight at a worksite and investigate the effect of social influence on these variables. Female employees (age $M = 46.5$) with a BMI greater than 25 consented and enrolled in the 10-week intervention ($n = 58$) or control ($n = 38$) group. Intervention ($n = 41$) and control ($n = 32$) participants completed the WEL-SF, PAAI, SR-Eat, and SR-PA questionnaires and weight measurements at week-1, 10, and 14. A sub-set of intervention participants ($n = 11$) completed interviews during week-11 and 12. Using mixed ANOVA, only WEL-SF scores were significant for between-subjects effects ($p < .01$). Time and time-by-group effect were significant for weight and BMI ($p = .01$, $p = .00$), SE-Eat, SR-Eat ($p = .00$), SE-PA ($p = .00$, $p = .02$ respectively), and SR-PA ($p = .00$, $p = .04$ respectively). Independent *t*-tests were significant for SE-Eat and SR-Eat at week-10

($p \leq .01$). Intervention group paired *t*-tests were significant for increased SE-Eat, SR-Eat, SE-PA, SR-PA, fruit intake, strength/stretching, and aerobic exercise ($p \leq .01$), and decreased weight and BMI ($p \leq .01$) at week-10 and 14. Attendance correlated with weight loss, SR-Eat, and aerobic exercise ($p \leq .05$). Change in SR-Eat was correlated with change in weight at week-10 ($r = -.43$, $p = .01$) compared to change in SE-Eat and weight ($r = -.35$, $p = .02$). Interviewees perceived limited social influence of co-workers. Social influence on SE and SR included themes of support, role modeling, competition, accountability, and motivation. Behavioral-based worksite weight-loss interventions can influence SE, SR, lead to weight loss, and changes in eating and exercise behaviors. Attendance is a factor for SR and weight loss outcomes. SR for eating behavior was stronger than SE for weight loss outcomes. Social influence played a small role, but interviewees did not perceive it as a strong influence.

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CHAPTER I

INTRODUCTION: PROSPECTUS

The workplace provides an opportunity to address overweight and obesity-related health care costs as adults spend nearly one third of their time at work (Workplace health promotion, 2014). Overweight and obesity affects 69% of adults in the United States (Ogden, Carroll, Kit, & Flegal, 2014), and medical expenditures have been estimated at $209.7 billion per year (Cawley & Meyerhoefer, 2012). Employers pay nearly $93 billion per year for obesity related costs that are likely to continue to rise. Workplace health-promotion programs can help reduce obesity related costs. However, there is underutilization of effective programs due to poorly designed interventions (Workplace health promotion, 2014).

Nutrition and physical activity worksite interventions addressing overweight and obesity have resulted in modest effects on weight, lacking clinically meaningful results. Researchers attribute this to education-focused interventions, which may not address specific weight loss behaviors and lack a theoretical basis in behavior change theory (Annesi, 2011c). Worksite intervention studies that have included a theoretical approach suggest a cognitive-behavioral or motivational enhancement strategy may result in better weight loss outcomes (L. M. Anderson et al., 2009; Hutchinson & Wilson, 2011; Touger-Decker, O'Sullivan-Maillet, Byham-Gray, & Stoler, 2008). Cognitive-behavioral strategies for weight management may influence degree of self-efficacy (SE), confidence in ability to perform a behavior (Bandura, 1994), and the use of self-regulation (SR), using self-reflection strategies to influence behavior and motivation (Bandura, 1991). SE and SR for weight management behaviors are factors identified as important for weight loss outcomes in other settings and are factors researches should evaluate in weight loss intervention programs (Annesi, 2011a, 2011b, 2011c).

Perceived SE, confidence in one's ability to perform a specific behavior (Bandura, 1994), and SR, ability to use self-reflection to affect one's own motivation and behavior (Bandura, 1991), are key variables in Social Cognitive Theory (SCT) (Bandura, 1989). Principles of SR include self-monitoring of causes and effects of behaviors, self-judgment, and emotional self-reactions to behaviors. Greater use of SR is associated with increased motivation, effort toward achieving goals, positive emotions, and self-directedness. SR may influence SE via the degree of personal adequacy in the self-judgment domain. In turn, SE may be a determinant of SR through influencing individual thoughts, motivation, emotions, and choice of actions (Bandura, 1989, 1991, 1994). Higher levels of SE are associated with greater effort, commitment, positive outcome expectations, and perseverance toward achieving goals such as desired weight loss. A stronger sense of self-efficacy increases resilience, ability to overcome obstacles or setbacks, and coping skills, which allow individuals to perform better under difficult situations (Bandura, 1994). Those attempting weight loss run into obstacles such as easy access to unhealthful food choices, negative emotions, competing commitments for time, and stressful life events. Successful weight loss requires sustained attention to efforts toward healthier eating patterns and increasing physical activity behaviors. Therefore, increasing the degree of SE and SR as they relate to healthful eating and exercise behaviors would likely result in greater weight loss success.

Furthermore, the concept of social influence, which focuses on behaviors of individuals and how they are influenced by others, is at the root of SCT and includes the construct of observational learning, learning by watching others behaviors (McAlister, Perry, & Parcel, 2008). This suggests that social influence may influence weight loss behaviors, including SR behaviors, in another co-worker through observation of behaviors. Both observational learning and SR are associated with SE (McAlister et al., 2008). Understanding the role of social influence in worksite wellness settings can aid in designing effective programs.

This study assessed the influence of a behavior change intervention for weight management on SR, SE and weight change to determine its effectiveness in addressing overweight and obesity in a worksite setting and investigated the effect of social influence on these variables. Effective interventions for weight loss that aid in lowering costs of obesity are of interest to employers and wellness program planners. Health educators involved in program implementation will benefit from improved knowledge of effective strategies for addressing obesity in adults in a worksite setting.

Statement of the Purpose

The first objective of this mixed-methods study is to quantitatively evaluate the change in SE for eating and exercise behaviors, change in SR for eating and exercise behaviors, and weight change during a 10-week worksite weight loss, theory-based behavior change intervention in adult female employees compared to controls. The second objective is to generate themes about participants' perceptions of how social influence of co-workers may affect change in SE and SR for eating and exercise behaviors, and weight change using semi-structured interviews. The third objective included evaluating the relationships of change in SR, SE, weight, fruit and vegetable intake, and exercise frequency.

Research Question

How do female participants in a worksite weight loss program describe the effect of social influence on change in SE and SR for eating and exercise behaviors and weight?

Hypotheses

The following null hypotheses were tested at the 0.05% level of significance.

When comparing participants to controls in the pre- and post-tests, there will be no statistically significant difference in:

1. SE for eating and exercise as measured by the Weight Efficacy Lifestyle Short Form (WEL-SF) questionnaire and the Physical Activity Appraisal Inventory (PAAI).
2. SR for eating and exercise as measured by the Self-regulation for Controlled Eating (SR-Eat) and the SR for Physical Activity (SR-PA) scales.
3. Body weight as measured by the Tanita Body Composition Analyzer digital scale in pounds.

Delimitations

Delimitations of the study included:

- Adult women 20 years and older with a body mass index greater than 25

- Female employees of the University of Texas Southwestern Medical Center
- Able to be physically active and consume food patterns consistent with the U. S. Dietary Guidelines, DASH diet, or Mediterranean Diet
- Must not have participated in a worksite weight loss program in the past six months

Limitations

Limitations of this study included the following:

- The study sample was based on employees who chose to enroll voluntarily in the worksite weight loss program offered as part of the employee wellness initiative. People who choose to volunteer may be more highly motivated for weight loss than non-volunteers, which could influence perceived self-efficacy and use of self-regulatory behaviors.
- The results of the study are generalizable only to overweight or obese adult women that meet delimitation criteria.
- The results will not be generalizable to overweight or obese men or specific races or ethnicities.

Assumptions

Assumptions of this study included the following:

- Individuals are able to self-assess their degree of self-efficacy and use of self-regulatory strategies on survey instruments honestly and accurately.

- Individuals will accurately self-report time spent in physical activity and intake of fruits and vegetables.
- There is an assumption that the curriculum of the 10-week program was developed and implemented in a manner that influenced use of self-regulatory strategies, self-efficacy, and weight of participants.

Definition of Terms

SELF-EFFICACY FOR EATING – the confidence in one's self to be able to prevent overeating under circumstances such as social situations, stress, negative mood, physical sensations, or food accessibility when not hungry (Byrne, Barry, & Petry, 2012)

SELF-EFFICACY FOR EXERCISE – the confidence in one's self to be able to participate in physical activities under circumstances such as competing time commitments or activities, discomfort, lack of energy, or lack of support (Byrne et al., 2012)

SELF-REGULATION FOR EATING AND EXERCISE– use of self-monitoring, goal setting, positive emotions, and rewards for controlling eating and exercise behavior (Saelens et al., 2000b)

SOCIAL INFLUENCE - actions of others influence what you do and think (Heaney & Israel, 2008).

Importance of Study

Worksite weight loss programs have had little success in reaching clinically meaningful weight loss and few studies report the use of a theoretical basis (L. M. Anderson et al., 2009). Interventions that focus on strategies for enhancing social influence, SR skills, and SE for eating and exercise may lead to greater success. Evaluating the worksite weight-loss programs' ability to increase SR skills usage and SE factors for eating and exercise behaviors will provide insight for areas of program improvement and increased effectiveness of worksite weight loss interventions. Qualitative data describing the role of social influence on SR, SE, and weight loss will contribute to the body of literature as little has been done in this regard. Overall, effective weight management programs in the workplace will help employers reduce employee healthcare costs and other costs in the workplace associated with excess body weight and physical inactivity.

CHAPTER II

LITERATURE REVIEW

Adult overweight and obesity is a health issue of concern related to leading causes of morbidity and mortality. Approximately 69% of adults in the United States are classified as overweight or obese (Ogden et al., 2014). Following is a discussion of the epidemiology, contributing factors, risk of mortality, costs of overweight and obesity, and theoretical constructs related to weight management behaviors. Effective theory based weight management programs in the workplace provide an opportunity to address overweight and obesity. Constructs of social cognitive theory including self-efficacy (SE), self-regulation (SR), and social influence (SI) may play a role in promoting healthy eating and physical activity habits for healthier body weights. A review of the existing literature evaluating SE, SR, and SI relating to eating and physical activity behaviors for weight management will conclude this chapter.

Overweight and Obesity

Defining and Identifying Overweight and Obesity

The National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health (NIH) defines overweight as a body mass index (BMI) of 25 to 29.9 kg/m^2 and obesity as a BMI of greater than 30 kg/m^2. The classification of obesity includes class I, II, or III, which corresponds to the BMI ranges of 30 to 34.9, 35-39.9, and greater than

40, respectively (U.S. Department of Health and Human Services, National Institutes of Health, & National Heart, Lung, and Blood Institute, 1998). A drawback of using BMI to categorize individuals as overweight or obese, is that BMI is not a direct measure of body fat. Body fat may be a better measure of obesity. A high percentage of lean muscle tissue could result in a BMI classification of overweight or obese although this is likely to occur only in an athletic population (Flegal, Carroll, Ogden, & Curtin, 2010). Despite this shortcoming, BMI remains the standard method of determining weight classification and is a clinical diagnostic indicator of obesity (Jensen et al., 2014). Standard guidelines of percent body fat do not exist for overweight and obesity diagnosis as an alternative to BMI. Body fat analysis also comes with additional shortcomings in methods of measurement, ease of use in clinical settings, and cost barriers to obtaining the most accurate and valid measurement using methods such as dual X-ray absorptiometry (DEXA), magnetic resonance imaging (MRI), or hydrostatic weighing.

Measuring waist circumference in conjunction with BMI provides a better indicator of body fatness in the absence of body composition measurements. Waist circumference is an indicator of distribution of body fat and is easy to use in a clinical setting. Greater waist circumference positively correlates with greater abdominal adiposity. A waist circumference greater than 40 inches in men and greater than 35 inches in women is an indicator of abdominal obesity. In addition to BMI, it is also an indicator of risk of the development of hypertension, type 2 diabetes (T2D), and cardiovascular disease (CVD), common co-morbidities associated overweight and obesity (Seagle, Strain, Markis, & Reeves, 2009; U.S. Department of Health and Human Services et al., 1998).

Trends and Epidemiology of Overweight and Obesity

Trends. The National Health and Nutrition Examination Survey (NHANES) is the primary national surveillance survey used to track trends in prevalence of overweight and obesity among a number of other health and nutrition related factors, and is a major part of the public health surveillance system. The National Center for Health Statistics conducts the survey. It is the only nationally representative survey known to use objective measures of height and weight. The Behavioral Risk Factor Surveillance Survey (BRFSS) collects height and weight data at the state level; however, it is self-reported data. NHANES began as a periodic survey in the 1970s and became an annual survey in 1999 as part of an effort to coordinate activities and reduce redundancy in data collection and reporting among government agencies under the National Nutrition Monitoring and Related Research Program. About 5000 people per year are evaluated for objective and subjective health and nutrition related measures in traveling medical trailers. Results of NHANES findings influence public health policy such as goals and objectives of Healthy People 2020, Dietary Reference Intakes, Dietary Guidelines for Americans, and initiatives of the Centers for Disease Control and Prevention (CDC).

Adult overweight and obesity is a national public health concern due to the trend of increasing prevalence in past decades uncovered by NHANES and BRFSS. The trend of rising overweight and obesity rates likely began in the mid 1970s. Flegal, Carroll, Kuczmarski, and Johnson (1998) evaluated the trends in overweight and obesity from

1960 to 1994 using the results from four consecutive nationally representative surveys including NHANES III. Data analysis indicated that the overall age-adjusted prevalence of overweight (BMI 25-29.9) remained relatively stable at approximately 30% of the population over this time-period. However, the overall prevalence of obesity (BMI greater than 30) increased from 12.8% to 22.5% with the greatest increase occurring between 1976 and 1994. This trend of increasing obesity was consistent for males and females, race and ethnicity, and age groups.

NHANES 1999-2000 found a continuing trend in overweight and obesity for all groups. The population as a whole continued to become more overweight and obese. The age-adjusted prevalence of overweight and obesity combined increased from 55.9% (NHANES III, 1988-1994) to 64.5%. The prevalence of obesity climbed nearly 8%, from 22.5% to 30.5%. The prevalence of class III obesity (BMI greater than 40) at 4.7%, was a significant rise from 2.9% (Flegal et al., 1998; Flegal et al., 2002).

Overall overweight and obesity continued to rise but at a slower rate between NHANES 1999-2000 through 2007-2008. Using a nationally representative sample of 5,555 adult men and women, Flegal et al. (2010) found an overall obesity prevalence of 33.8%, up from 30.5% in NHANES 1999-2000. The prevalence of overweight and obesity combined increased from 64.5% to 68% (Flegal et al., 2010). Although this slowed overall rate of growth in overweight and obesity was welcome, concern for public health remained, as there was no indication that people were getting any thinner and the nation was far from being on target to meet Healthy People 2010 goals.

The slowed rate of growth continued with overall obesity inching up almost 2% between NHANES 2007-2008 to 2009-2010 and combined overweight and obesity increasing by less than 1%. Unfortunately, those who were obese became more obese during this period and about 1% who were normal weight or overweight moved up by one BMI category (Flegal, Carrol, Kit, & Ogden, 2012).

NHANES 2011-2012 continues to support a leveling-off of overweight and obesity prevalence occurring in the past 10 years. Again, the trend of those who are overweight are remaining overweight and those with obesity continue to become more obese. NHANES 2011-2012 shows no significant increase in the overall prevalence of age-adjusted overweight, 68.5%, and obesity, 34.9%, since 2003-2004 (Ogden et al., 2014).

Likewise, state-specific data from the BRFSS tells a similar story of rising obesity rates over the past few decades. From 1991 to 1998 BRFSS showed a nearly 6% increase in the rate of obesity among adults 18 years and older, further confirming public health concerns. There was a steady increase in prevalence across all states, ages, both genders, and races. The greatest magnitude of increase was in the southern and Atlantic states and Hispanic ethnic groups. In 1991, only four states had obesity rates greater than 15% and no states more than 20%. This changed in 1998 with 33 states falling in the 15 to 19% range and seven states had obesity rates greater than 20% (Mokdad et al., 1999). By 2000, BRFSS estimated obesity prevalence at 19.8% and found 23 states with prevalence between 20 to 24% (Mokdad et al., 2001). Jumping ahead to 2009, nine states had obesity prevalence rates greater than or equal to 30% and no states met the Healthy People 2010 goal of less than 15% (Centers for Disease Control and Prevention, 2010).

The latest BRFSS data concur with the latest findings of NHANES. The overweight are remaining overweight and the obese are becoming more obese as evidenced by 2013 obesity prevalence maps showing no states with less than 20% obesity prevalence, 23 states with 25 to 30%, 18 states with 30 to 35%, and now two states in a new category of 35% or greater (Centers for Disease Control and Prevention, 2014).

Age and gender. Overweight and obesity rates have historically differed among age groups and genders. In general, overweight and obesity increases with increasing age categories, and women overall were more likely to be obese compared to men (Flegal et al., 1998). Men and women in the 60-69 age category had the greatest prevalence of obesity, 38.1% and 42.5% respectively, and the greatest percent change from NHANES III (1988-1994) to NHANES 1999-2000, 13.3% and 12.7%, respectively, a time period in which obesity rates were rising rapidly (Flegal et al., 1998; Flegal, Carroll, Ogden, & Johnson, 2002). Despite these large increases, women overall showed no significant trend for increasing overweight or obesity during the nearly 10-year period from 1999 to 2008. However, men did have a significant rise in obesity by 4.7% over this period. A concerning finding was the significantly higher odds ratio for obesity among the 40-59 year old age group in which men were 1.46 times more likely to become obese, and women were 1.5 times more likely to become obese. The odds ratios of the 60 years or more age group for both men and women also significantly increased. This suggests adults are becoming obese at younger ages and therefore living longer with excess weight (Flegal et al., 2010).

Although women continue to be more likely to be obese and men more likely to be overweight, the obesity gender gap has narrowed over the years due to increasing rates of obesity among men. NHANES 2009-2010 results based on 5,926 adult men and women found the age-adjusted prevalence of obesity was 35.8% in women and 35.5% in men. This is less than a 0.5% change for women and less than 3.5% change for men since NHANES 2007-2008. The age-adjusted mean BMI was the same for men and women, 28.7, and the median BMI only differed by a half point and only rose by one point over a 10-year period (Flegal, Carrol, Kit, & Ogden, 2012). The most recently reported NHANES findings suggest a possible widening in the gender gap with 33.5% of men and 36.1% of women who are obese. Obesity significantly increased among women in the 60 and older age category, moving from 31.5% to 38.1% (Ogden et al., 2014). Continued surveillance is necessary to evaluate these changes further.

Race and ethnicity. Trends show overweight and obesity disproportionately affects minority groups compared to whites. From 1988 to 1994, Mexican-Americans had the highest prevalence of overweight and obesity combined (67.4%) compared to whites with the lowest prevalence (52.6%). Non-Hispanic blacks had the highest prevalence of obesity overall (30.2%) compared to whites with the lowest obesity prevalence (21.2%). When separated by gender, Mexican-American men were more likely to be overweight compared to black or white men, and non-Hispanic black women had the highest prevalence and obesity (37.4%). This was 15% higher than the obesity prevalence found for white women (Flegal et al., 1998).

Between NHANES III and NHANES 1999-2000, black women became more obese at a faster rate than Mexican-American and non-Hispanic white women did. Nearly 80% of black women were either overweight or obese compared to only 71.9% of Mexican-Americans and 57.3% of white women. Black women had the greatest percent change in obesity overall (11.5%) and for class III obesity (15.1%). This compares to the lowest percent change in obesity overall of 4.4% and class III obesity 0.7% for Mexican-American women (Flegal et al., 1998; Flegal et al., 2002).

The trend of higher rates of overweight and obesity among non-Hispanic blacks and Mexican-Americans have continued to rise. According to NHANES 2007-2008, non-Hispanic black women were 2.26 times more likely to be obese compared to white women, and Mexican-American women were 1.53 times more likely to be obese than white women. Both non-Hispanic black women and men continued to have the highest prevalence of class III obesity (Flegal et al., 2010). Although significant changes in prevalence were not found in women overall from 1999 to 2010, there were statistically significant increases in obesity for non-Hispanic black and Mexican-American women. Obesity prevalence increased for non-Hispanic black women to 58.5% and for Mexican-American women to 44.9%. The age-adjusted prevalence of class II and III obesity for non-Hispanic black men shifted from 14.4% in 2007-2008 to 20% in 2009-2010 and from 27.9% to 30.7% in non-Hispanic black women for the same time-period (Flegal et al., 2012). Furthermore, overweight and obesity continue to be disproportionately greater among Hispanics and non-Hispanic blacks compared to whites and for the first time, NHANES 2011-2012 has reported on non-Hispanic Asians. Non-Hispanic Asians have overweight (38.6%) and obesity (10.8%) rates well below that of any other race or ethnic group (Ogden et al., 2014).

Etiology of Overweight and Obesity

Overweight and obesity result from a consistent energy imbalance in which energy intake exceeds energy output over time (Gropper & Smith, 2013; Hill & Melanson, 1999; Seagle et al., 2009). Energy balance occurs when energy intake is equal to energy output and results in a stable weight. Energy intake is relatively simple, consisting of the amount of energy consumed from both foods and beverages. Energy output is more complex and is made up of a three main components that include basal metabolic rate (BMR) (portion of energy output used for physiological functioning of the body), thermic effect of food (energy used for digestion, absorption, metabolism, and storage of fat, protein and carbohydrate), and physical activity. Total body mass, amount of lean muscle tissue, changes in body temperature or room temperature, periods of growth, age, and genetics influence an individual's BMR. Hormones, medications, and some disease states may increase or decrease BMR and affect the efficiency of energy is storage or utilization (Gropper & Smith, 2013). Additionally, environmental and behavioral factors influence energy intake and output, and subsequently body weight and composition. A more detailed discussion of the influence of genetic, metabolic, environmental, and behavioral factors on body weight and composition is included below.

Genetic factors. It is well established that genetics play a role in influencing body weight, composition, and fat distribution (Albuquerque, Stice, Rodriguez-Lopez, Monco, & Nobrega, 2015). More than 120 genes associated with the predisposition for obesity have been identified and a large number of them are associated with the regulation of food intake and energy balance (O'Rahilly & Farooqi, 2008; Rankinen et al., 2006). Defects in specific genes may affect appetite control mechanisms as well as distribution and deposition of body fat. An example of this is the gene that codes for the production of leptin, a hormone produced by fat cells that suppresses appetite and controls fat storage. Individuals with a gene deletion for leptin production have a voracious appetite and a high body weight and high body fat. When given leptin, appetites return to normal levels and body weight and fat decrease (Bray & Champagne, 2005). Defects in genes that code for melanocortin receptors also affect metabolic appetite control mechanisms, leading to obesity (Bray & Champagne, 2005; Gropper & Smith, 2013). Other genetic defects result in lipodystrophy conditions in which individuals may store body fat in very specific locations such as the face and neck but not in the extremities and some have almost no body fat stores at all (Rankinen et al., 2006). These types of genetic defects are typically monogenic or single gene defects and affect only about 5% of the population worldwide (Albuquerque et al., 2015).

Identical twin studies also provide evidence for the influence of genes on body weight and composition. Over or underfeeding studies resulted in similar outcomes among identical twins. When comparing twin pairs, variations in response to over or underfeeding differ with some pairs gaining or losing more weight. These studies suggest genetics may have as much as 70-90% influence on body fat (Albuquerque et al., 2015; Rankinen et al., 2006).

Adoption studies have also shown a genetic influence on body fat, shape, and weight. Adopted siblings tend to have similar body shapes and sizes. Genetics may have a 35-45% influence on body fat among siblings. Adopted children are much more likely to have BMI's similar to their biological parents than adoptive parents (Albuquerque et al., 2015). This type of genetic influence is polygenic, meaning multiple genes are working together to influence body weight and adiposity.

Common obesity among the population is believed to be polygenic, resulting from several genes and variants within genes that make up a unique genetic profile for each individual. This allows susceptibility for obesity but does not directly cause obesity without an environmental influence (O'Rahilly & Farooqi, 2008; Rankinen et al., 2006). It is believed that this polygenic influence on body fat and weight protects against starvation and allows for greater chance of survival (Albuquerque et al., 2015). This is often referred to as the thrifty gene hypothesis. However, it does not serve us well in today's environment in which low-cost, highly palatable, high-energy food is easily available and the need for physical effort has been engineered out of daily tasks.

Despite evidence of a strong genetic influence and predisposition for body weight and adiposity, many experts believe our lifestyle and environment influences how our genes respond. In addition, many contend that genetics alone cannot explain the rapid increase in the prevalence of overweight and obesity in the past 30 years (Albuquerque et al., 2015; Bray & Champagne, 2005; Gropper & Smith, 2013; Hill & Melanson, 1999; O'Rahilly & Farooqi, 2008; Rankinen et al., 2006).

Metabolic factors. Metabolism is a multifaceted system of how our bodies use energy derived from fat, carbohydrate, and protein. It includes complex interactions of chemical signaling of hormones and steroids produced within the body to maintain homeostasis of the regulation of energy intake and output. Metabolic regulation of energy intake and output therefore can influence body weight and adiposity by affecting energy balance (Gropper & Smith, 2013).

Metabolic hormones including leptin, ghrelin, insulin, cholecystokinin, and others act on the gastrointestinal tract and parts of the brain (mainly the hypothalamus) that control food intake. Leptin is a hunger-suppressing hormone produced by white fat cells. The more white fat cells, the more leptin produced to reduce appetite as a means to control the amount of energy stored as fat. In a fed state, leptin increases, signaling a sense of fullness. Cholecystokinin and insulin also rise during the fed state. Cholecystokinin signals the sense of satiation particularly in response to dietary fat and protein, whereas the degree of insulin response is influenced mostly by dietary carbohydrate intake. The combination of these hormones inhibits eating and encourages energy storage (Blundell, 2006; Gropper & Smith, 2013).

In a fasted state, leptin decreases, which signals that energy intake is low or energy stores are being used. An increase in ghrelin, a hunger-stimulating hormone, counters the decrease in leptin. Ghrelin is produced in the gastrointestinal tract and increases when the stomach is empty. Ghrelin, along with other hormones, signals the brain that there is a need for food energy. Ghrelin decreases as food enters the stomach. This metabolically controlled energy-balancing act generally works quite well to maintain body weight and is a key factor in why losing weight and maintaining weight loss is difficult. When an individual chronically reduces energy intake for the purpose of weight loss, the signals of hunger from ghrelin production may be too strong to resist and lead to excess energy intake (Blundell, 2006; Gropper & Smith, 2013).

Because fat cells produce leptin, one might expect levels to be higher in obese individuals due to higher levels of body fat. This is not necessarily true. Some people with obesity may have high or low leptin levels and are resistant to leptin's effects, leaving them with a feeling of chronic hunger. These individuals do not receive or sense the hunger suppressing effect of leptin which can result in a greater energy intake above output. Energy intake that is greater than output leads to weight gain. The mechanism of why or how leptin resistance occurs remains undecided. Insulin resistance is also a problem in many individuals with obesity and affects satiety signaling as well (Blundell, 2006; Gropper & Smith, 2013).

Moreover, the hedonic appetite control system that responds to the sensory aspects of food may override the metabolic energy control system. Foods high in fat, salt, and sugar are among the most palatable, may drive appetite and cravings, and may increase the desire to eat more. These types of foods may increase a sense of pleasure. Individuals can ignore metabolic physiological signs of fullness and satiation in the presence of large portion sizes of highly palatable foods, leading to an imbalance of energy intake and output, ultimately increasing body weight over time (Blundell, 2006; Gropper & Smith, 2013).

Environmental factors. Environmental factors that influence energy intake and output include abundant and easy access to food, improved technology, lower cost of energy-dense foods, large portion sizes, and decreased opportunities for physical activity.

We live in a time in which we have access to more calories and nutrients than needed for daily life. Compared to 1970, Americans were consuming an estimated 459 more kilocalories per day in 2010. Refined grains, added sugar, and added fats make up the bulk of these additional kilocalories. The U.S. food supply provides about 3900 calories per day per capita after adjusting for losses (USDA Economic Research Service, 2014). This is about twice the number of kilocalories needed per day for most adults. Advances in agricultural and food science technology have led to this increased food supply along with lower food costs (Philipson, Dai, Helmchen, & Variyam, 2004). Lower cost of food is associated with higher intake of food. Furthermore, high energy-dense foods, namely high fat and sugary foods cost less than low energy dense foods (fruits, vegetables, lean meats) which may partially explain higher rates of obesity in lower economic categories (Monsivais & Drewnowski, 2007). Regardless of economic status, this environment of abundant kilocalories and relatively low cost food is likely influencing overall energy intake and balance and subsequently weight status.

Additionally, portion sizes have grown along with waistlines since the 1970s with a sharp rise in the 1980s. Increased energy intake accompanies larger portions and therefore contributes to increasing body weight (Young & Nestle, 2002). When comparing marketplace portions to federal standard portion sizes, marketplace portion sizes ranged from two to eight times greater in size (Young & Nestle, 2003). Additionally, individuals served larger portions sizes eat more without reporting increased levels of satisfaction and fullness. This supports the idea that people can and do ignore physiological signs of fullness (Ello-Martin, Ledikwe, & Rolls, 2005). Thus in an environment of consistent exposure to excessive portions sizes one could expect increased energy intake over output and increased body weight and fat.

Another environmental factor is access to restaurant prepared foods. Restaurant meals tend to be higher in kilocalories than meals prepared in the home. Fast food intake and a higher proportion of fast food locations in an area compared to full-service restaurants are associated with higher body weight (Hollands, Campbell, Gilliland, & Sarma, 2014; Mehta & Chang, 2008). Policies aimed at controlling the density of fast food restaurants in neighborhoods may be a means to influencing energy intake to address overweight and obesity at an environmental level.

Lastly, the environment influences energy output by affecting physical activity levels. For example, the home and workplace environments have changed with improvements in technology. Microwaves, dishwashers, and washing machines have reduced the energy output needed for daily household chores. Automated machines and computers have reduced energy output in the workplace making American workers much more sedentary on the job. A sufficient reduction in energy intake has not matched this reduction of energy expenditure, resulting in a gradual rise in body weight (L. M. Anderson et al., 2009; Hill & Melanson, 1999).

Likewise, the designs of communities in which we live and work affect physical activity levels. Population density and intersection density appear to influence walkability and active transport within communities (Grasser, Van Dyck, Titze, & Stronegger, 2013). Increased level of walkability is associated with a decreased risk of excess weight. In addition, neighborhoods in which a greater number of individuals walk to work are associated with a decreased risk of obesity (Smith et al., 2008). Consequently, community designs that promote walking have the potential to support increased energy output and affect weight status.

Lifestyle behavioral factors. Lifestyle behaviors related to weight status include the quantity, quality, and types of food and beverage choices and amount of time engaged in physical activity. The Scientific Report of the 2015 Dietary Guidelines Advisory Committee concluded that few changes have been made in dietary intake patterns over the years. Fruit intake has remained stable below recommended levels with only about 15% of the population achieving the recommendation of 1.5 to 2 cups per day. Only 20% of adult men and 30% of adult women meet the recommended 2 to 3.5 cups of vegetables per day. Almost no one achieves the recommended intake for whole grains and 80% of the population falls short on meeting the dairy or dairy substitute recommended intake. In contrast, intake of solid fats and added sugars exceed the recommend limits of USDA dietary patterns even with evidence of decreasing intakes of added sugar more recently. Sweetened beverages, snacks, and sweets are major contributors of added sugars and solid fats in the diet (Department of Health and Human Services & US Department of Agriculture, 2015).

As previously mentioned, Americans were consuming approximately 459 more kilocalories per day in 2010 than they were in 1970 according to the Economic Research Service (2014), with most of the extra calories coming from added sugars, fats, and refined grains. NHANES data shows a 314 kilocalorie per day increase for mean energy intake from NHAHES I to NHANES 2003-2004 (Ford & Dietz, 2013). Despite the discrepancy in the reported increase of kilocalories, either one is adequate to explain the rise in overweight and obesity across the population. Thankfully, there is some good news. From NHANES 1999-2000 to 2009-2010, there has been no increase and possibly a slight decrease in energy intake that may also explain the leveling off in BMI trends (Ford & Dietz, 2013). The bottom line is that decreasing intake of added sugars and solid fats will reduce energy intake without compromising quality of nutrient intake as they provide little to no essential nutrients. This is a relatively easy place to start for creating an energy deficit that promotes weight loss.

Added sugar intake has been associated with overweight and obesity along with other chronic diseases such as diabetes and CVD. Both the 2010 Dietary Guidelines and Healthy People 2020 aim to reduce intake of added sugar and a similar message is expected with the release of the 2015 Dietary Guidelines. Sugar sweetened beverages (SSB) are a predominant source of added sugars in the diet with soft drinks at the helm. NHANES 2007-2008 reported daily SSB intake by 50% of adults greater than age 35 and 73% of young adults between 20 to 34 years old (Han & Powell, 2013). These numbers are higher than reported by BRFSS of which only 26.7% of adults reported consuming one or more SSB per day (Kumar et al., 2014). BRFSS only included soft drinks and fruit drinks, whereas NHANES includes sports and energy drinks, sweetened tea and coffee, and other sweetened beverages.

Mean energy intake from SSB among adults in 2009-2010 was 151 kilocalories per day, contributing 6.9% of daily energy intake (Kit, Fakhouri, Park, Nielsen, & Ogden, 2013). This is equivalent to about eight teaspoons of sugar, which is above the World Health Organization's recommendation for no more than six teaspoons per day. From NHANES 1999-2000 to 2007-2008, the amount of added sugar coming from SSB decreased by about 25 g/day (100 kilocalories) and total energy intake from SSB decreased by almost 3.5%. Two-thirds of this decrease came from lower consumption of soft drinks. However, consumption of added sugar from energy drinks increased. Mean energy intakes of total added sugar, 14.6% of daily energy intake, were still above recommended amounts (Welsh, Sharma, Grellinger, & Vos, 2011).

Added sugars and fats increase the energy density of foods and overall diet. Energy density is the available energy in a unit of measurement of a food or beverage. Recent research supports that high-energy-dense diets are associated with greater energy intake and obesity, while low-energy-dense diets are lower in total energy intake and associated with a healthy weight. In addition, people who consume more fruits and vegetables have lower energy-dense diets and the least obesity (Ledikwe, Blanck, Kettel Khan et al., 2006). Moreover, low energy dense diets are higher in essential micronutrients and water and lower in fat and caloric beverages compared to high energy dense diets (Ledikwe, Blanck, Khan et al., 2006). Choosing fruits and vegetables over added sugars and solid fats decreases the energy density of the overall diet and improves diet quality, making it a possible strategy for weight management and health promotion.

Choosing a physically active lifestyle is also important for health and weight management. Only 21% of adults meet the 2008 Physical Activity Guidelines for cardiovascular and resistance training physical activity. Physical activity levels are lower among groups that tend to have higher overweight and obesity rates. For example, physical activity levels are lower in women compared to men and lower in Blacks and Hispanics compared to Whites (Blackwell, Lucas, & Clarke, 2014). Adults who are regularly physically active generally have less body fat, more lean mass, healthier body weights, and lower risk of CVD, diabetes, and osteoporosis. Overweight and obese adults who are regularly physically active receive the same health protecting benefits as normal weight active adults (Department of Health and Human Services & US Department of Agriculture, 2015).

Physical activity is the main component of energy expenditure that we have the most control over and is the most variable depending on an individual's frequency and intensity of activity. Energy expenditure by physical activity plays a role in the prevention of weight gain and promotion of weight loss. High levels of physical activity are associated with less obesity and low levels are associated with greater obesity. A report by the Advisory Committee for the 2008 Physical Activity Guidelines stated that 150 minutes per week of moderate to vigorous activity could lower body weight by up to 3% (Jakicic & Davis, 2011). Higher physical activity levels, 150 to 300 minutes per week, have a greater effect on weight loss in overweight adults, and are associated with better eating habits that help facilitate weight loss (Jakicic et al., 2011). Combining exercise of greater than 250 minutes per week with a modest reduction in energy intake can result in even greater body weight and fat loss in obese individuals (Rankin, 2015). Therefore, weight management programs that address physical activity behavior and energy intake reduction may be more effective than a one sided approach.

The 2013 practice guidelines for weight management in overweight and obese adults recommend that comprehensive lifestyle intervention programs include a reduced energy diet, increased physical activity, and use of behavior modification strategies to achieve lifestyle changes (Jensen et al., 2014). Recommendations are to lose weight for individuals with a BMI greater than 30 or with a BMI of 25 to 29.9 who have additional comorbid risk factors for CVD. These risk factors include hypertension, dyslipidemia, diabetes or pre-diabetes, and waist circumference greater than 35 inches for women and 40 inches for men (Jensen et al., 2014). Cardiovascular disease remains the primary cause of death in the U.S. (Heron, 2013) and key risk factors are obesity, poor dietary choices, and sedentary behavior. Comprehensive weight management programs have the potential to improve weight status and reduce mortality from CVD.

Risk of Mortality Related to Obesity

The relationship of overweight and obesity with mortality has a long history. An insurance company documented the relationship between body weight and mortality in 1942 when they found individuals with the greatest longevity had maintained a body weight similar to that of a 25-year old adult of the same height (Heymsfield & Cefalu, 2013). Several studies published since 1942 have confirmed the relationship of higher body weight to all-cause mortality and cause-specific mortality (Calle, Thun, Petrelli, Rodriguez, & Heath, 1999; Flegal, Graubard, Williamson, & Gail, 2007; Flegal, Kit, Orpana, & Graubard, 2013; Orpana et al., 2010; Whitlock et al., 2009). The highest classes of obesity, II (BMI 35-39.9) and III (BMI > 40), are associated with the greatest risk for mortality. A 12-year prospective study of 11,326 Canadian adults found a statistically significant relative risk of all-cause mortality of 1.36 times greater for obese men and women (Orpana et al., 2010). This compares to other studies reporting all-cause mortality for class II and III obesity with a relative risk of 1.22 (McGee, 2005) and a hazard ratio of 1.29 (Flegal et al., 2013). An earlier 14-year prospective study of greater than one million U.S. adults reported relative risks of 2.58 times greater in white men and 2.0 times greater in white women in the highest BMI classes. Obese black men and women had lower relative risk of mortality than whites (Calle et al., 1999). Although obesity in general is associated with increased mortality, when class I obesity is evaluated separately, risk of all-cause mortality is not significantly different from normal weight (Flegal et al., 2013; Orpana et al., 2010) and a difference in risk is found in overweight individuals. This difference may be due to a number of factors and a concept referred to as the ‘Obesity Paradox’, which is discussed later.

Overweight (BMI 25-29.9) is associated with a decreased risk and protective effect from all-cause mortality (Flegal et al., 2007; Flegal et al., 2013; McGee, 2005; Orpana et al., 2010). A meta-analysis of 97 studies and 2.8 million people by Flegal et al. (2013) found a hazard ratio of 0.94 for all-cause mortality in overweight compared to normal weight people. This is similar to a relative risk of mortality of 0.83 in overweight reported by Orpana et al. (2010) suggesting being overweight is protective. A smaller meta-analysis conducted by McGee (2005) found relative risks of 0.968 for overweight men and 0.965 for overweight women compared to normal weight for all-cause mortality. In contrast to overweight, being underweight is significantly associated with all-cause mortality (Flegal et al., 2007; Orpana et al., 2010). Orpana et al. (2010) reported a statistically significant relative risk of 1.73 times greater for underweight individuals compared to normal weight. Furthermore, the lowest overall mortality rates occur at a BMI of 22.5 to 25 (Calle et al., 1999; Whitlock et al., 2009).

Cause specific mortality. In addition to all-cause mortality, BMI is associated with cause-specific mortality. Flegal et al. (2007) estimated cause-specific mortality for standard BMI categories using NHANES I, II, III, and NHANES 1999-2002, along with 2004 vital statistics data. This included 2.3 million adults older than 25 years of age. Neither underweight nor overweight BMI classifications increased risk for mortality from cancer or CVD. However, an increased risk of death was associated with non-cancer and non-CVD causes in underweight individuals. Overweight was associated with a decreased risk of mortality from non-cancer and non-CVD causes (Flegal et al., 2007). A meta-analysis of 26 studies reported a relative risk of cancer mortality of 0.985 and 0.932 in overweight women and men compared to normal weight, respectively, suggesting a small protective effect of overweight. This same study found death from CVD in overweight to be similar to normal weight and reported a relative risk of 1.029 (3% increased risk) in women and 1.096 (10% increased risk) in men but did not consider this significant. The relative risk of coronary heart disease (CHD) mortality in the overweight was also not considered significantly different from normal weight (McGee, 2005). Therefore being overweight but not obese, may lessen the risk of mortality from cancer, and does not significantly increase risk of mortality from CVD or CHD.

In comparison, obesity is associated with a significantly increased risk of death from CVD and CHD but not all types of cancers in general (Flegal et al., 2007; McGee, 2005; Whitlock et al., 2009). Obesity was only associated with mortality from cancer if the type of cancer was considered to be obesity related. Types of cancers considered obesity related were colon, kidney, breast, uterine, esophageal, ovarian, and pancreatic cancer (Flegal et al., 2007). In comparing the most obese to the normal weight, McGee (2005) reported a relative risk of 1.57, 57% increased risk, for death from CHD and 1.48, 48% increased risk, for death from CVD. For every 5-point increase in BMI greater than 25, Whitlock et al. (2009) reported a 40% higher mortality related to vascular disease, 116% greater mortality for diabetes, 60% for renal disease, and 82% for liver disease.

Obesity paradox. Reasons for these seemingly paradoxical findings reported above given overweight and obesity are well-accepted risk factors for chronic disease are not completely clear, lack scientific consensus, and are a current topic of debate among obesity researchers and health professionals. Proposed arguments for why overweight and mild obesity might be found to be protective include the following: a healthy BMI changes as we age, cutoff points for BMI are not well chosen, BMI is not a good substitute for determining body fatness, BMI does not indicate central obesity, fitness may be an important indicator, and statistical bias due to most studies focusing on adults 40 years or older (Pack, 2015).

In a normal, generally healthy adult population, a U-shaped curve is evident when BMI is compared to all-cause mortality with lowest mortality rates occurring between 20 and 24.9. Those on the lowest and highest ends of BMI have the greatest risk of mortality (Berrington-de Gonzalez et al., 2010). A similar U-shaped curve is seen when comparing BMI and mortality in multiple disease states including coronary artery disease, heart failure, hypertension, end stage renal disease, pneumonia, and others. However, the bottom of the curve shifts to the right, a higher BMI range that may show protection up to a BMI of 32 (Pack, 2015).

The BMI and mortality curve also shifts to the right with aging. As age increases so does the BMI range related to lowest mortality (Childers & Allison, 2010). It is widely accepted that a higher BMI in community living older adults (70 years or greater) is protective against mortality compared to normal weight or thin older adults (Grabowski & Ellis, 2001). A recent meta-analysis confirms this showing the lowest mortality in adults over 65 to be associated with a BMI in the overweight range and increasing mortality at a BMI of less than 23 and higher than 33 (Winter, MacInnis, Wattanapenpaiboon, & Nowson, 2014).

Furthermore, overweight and obesity is associated with survival in people with serious illness, which is counter to the findings in the general population (Childers & Allison, 2010). Older adults have more chronic disease and likelihood of serious illness. Under-nutrition is another concern in older adults. Overweight or mildly obese likely have both greater nutrient and lean tissue stores and therefore may be better able to tolerate weight loss and negative effects of under-nutrition related to social aspects of aging, disease, and disease treatments (Winter et al., 2014).

The key for survival of serious illness may lie in the combination of overweight or obesity and maintaining lean tissue stores through adequate nutrition and fitness. Overweight and obesity was associated with survival rates in cancer patients receiving chemotherapy only if sarcopenia (loss of lean muscle tissue) was not present (Gonzalez, Pastore, Orlandi, & Heymsfield, 2014). Mid-arm muscle circumference, an indicator of body composition, adequacy of energy and protein intake, and nutrition risk status is associated with better outcomes and survival rates in patients receiving hemodialysis and patients with stage IV lung cancer (Noori et al., 2010; Tartari, Ulbrich - Kulczynski, & Filho, 2013). These studies demonstrate the protective effect of a higher body weight, lean tissue, and BMI on decreased risk of mortality.

Additionally, the measure of BMI itself is problematic. First, there is concern with whether or not the chosen BMI cutoff points are the best. A BMI of 18.5 is within a normal healthy range by current standards. However, increased mortality risk is actually evident at a BMI of less than 20. A BMI range of 22 to 27 may be a better normal category (Berrington-de Gonzalez et al., 2010; Pack, 2015). A shift in BMI categorization would influence statistical findings related to all-cause mortality. Second, BMI is also criticized for being a poor indicator of body fatness and central obesity. BMI is highly specific for obesity but has poor sensitivity for body fat. It fails to identify nearly half of individuals with excess body fat (Okorodudu et al., 2010). Over fatness can occur at normal BMI and people who are overweight or obese may not actually be over fat. Normal weight obesity (over fatness) is associated with metabolic abnormalities and increased health risk. Central obesity can also occur at normal and overweight BMI ranges and be absent in mildly obese as determined by BMI (Pack, 2015). Central obesity is an independent risk factor for mortality in people with coronary artery disease. Those with a normal BMI and central obesity have the highest mortality rates from coronary artery disease (Coutinho et al., 2013). Lastly, BMI is not a measure of fitness. For long-term mortality, it is better to be fit regardless of fatness or BMI. Fitness modifies negative health effects of obesity (Barry et al., 2014; McAuley et al., 2012). The mechanism behind this phenomenon is not fully understood. Research is ongoing.

Cost of Overweight and Obesity

The economic burden of overweight and obesity is substantial for public and private payers. In 2008 dollars, estimates of annual healthcare costs attributable to obesity range from $113.9 billion (Tsai, Williamson, & Glick, 2011) to $209.7 billion (Cawley & Meyerhoefer, 2012) depending on models used for determining costs. Finkelstein, Trogdon, Cohen, and Dietz (2009) estimated annual obesity related medical costs at $147 billion, 9.1% of national health expenditures, and found per capita medical spending for obese individuals was $1,429 (42%) greater than normal weight individuals. In addition, obesity was associated with a 46% greater cost for hospitalization, 27% more outpatient visits to physicians, and 80% greater spending for medications (Finkelstein, Trogdon, Cohen, & Dietz, 2009). An analysis of four high quality studies estimating direct costs of overweight and obesity concluded the direct cost per person of overweight and obesity to be $266 and $1,723, respectively and only 4.8% of national health expenditures (Tsai et al., 2011). Whereas Cawley and Meyerhoefer (2012) determined the pooled per capita annual medical cost attributable to obesity to be $2,741, or $3,613 for women and $1,152 for men. National health expenditures related to treating obesity according to Cawley and Meyerhoefer (2012) are 20.6%, twice as much as estimated by Finkelstein et al. (2009).

Although not all authors agree on the exact costs of overweight and obesity, they do agree that a continued rise in obesity will further drive up healthcare costs and that it is substantial and affects public and private payers of healthcare. Using BRFSS data from 1990 to 2008, Finkelstein et al. (2012) predicts a 33% increase in obesity and a 116% increase in severe obesity by 2030 if the rates of rise were to continue. This would result in 51% of the population with a BMI greater than 30 and a substantial increase in obesity related health expenditures. If obesity prevalence remained stable at 2010 levels, an estimated $549.5 billion in medical savings attributable to obesity could be realized. Additionally, a 1% decrease in the predicted trend by 2030 could result in $84.9 billion in savings (Finkelstein et al., 2012).

Employer Costs of Overweight and Obesity

Private payers of insurance cover nearly half of the annual expenditures related to obesity (Finkelstein, DiBonaventura, Burgess, & Hale, 2010). This includes employer-based health insurance, which covers approximately 149 million Americans of working age according to the Kaiser Family Foundation (2015). Insurance premiums increased by 3% from 2013 to 2014, and premiums are expected to continue to rise. The cost of the average annual premium for a single individual in 2014 was $6,025. The average employer contribution to this premium was $5,137, or about 82% (Kaiser Family Foundation, 2015). In addition to premium costs, employers cover the cost of medical claims for obesity related illnesses. However, obesity related medical costs are not the only obesity related cost burden to employers. Obesity is associated with work related absenteeism and presenteeism costs.

Cost of Weight Related Absenteeism and Presentism

Overweight and obesity in the workplace is positively associated with increased medical costs, lost productivity, absenteeism, and presenteeism (Andreyeva, Luedicke, & Wang, 2014; Finkelstein et al., 2010; Finkelstein et al., 2009; Gates, Succop, Brehm, Gillespie, & Sommers, 2008; Kleinman, Abouzaid, Andersen, Wang, & Powers, 2014; Van Nuys et al., 2014). Finkelstein et al. (2010) estimated the annual aggregate cost related to obesity for full-time employees to be $73.1 billion. The cost per capita of absenteeism, presenteeism, and medical expenditures ranged from $1,143 for grade I obesity (BMI 30 – 34.9) among men to $6,694 for grade III obesity (BMI > 40) among women. Costs were significantly greater for those with a BMI greater than 35, with just 37% of the people accounting for 61% of the excess cost (Finkelstein et al., 2010).

Another cross-sectional analysis of U.S. employers found that a BMI greater than 25 was associated with increased medical costs, increased probability of workers comp claims, and absence for any reason. Compared to normal weight, employees with a BMI greater than 40 had $3,880 more in covered medical expenditures per year (Van Nuys et al., 2014). Absenteeism and presenteeism may be just as costly to employers as the actual medical costs of obesity. Absenteeism is significantly greater among individuals with obesity compared to overweight or normal weight. The estimated cost of absenteeism attributable to obesity among American workers is $8.6 billion annually (Andreyeva et al., 2014).

Intervention Effects on Weight Related Expenditures

Addressing overweight and obesity in the workplace with employee weight-management intervention programs has the potential to reduce medical expenditures, although return on investment of employer provided weight-management programs may take several years to materialize. Dall et al. (2011) provides evidence for this argument in a study of TRICARE Prime enrollees in which the purpose was to estimate the change in lifetime medical expenditures attributable to obesity and lifetime disease prevention associated with weight loss. For every 1% permanent decrease in weight, lifetime medical expenditures decreased by $440 (Dall et al., 2011). Furthermore, a cohort study of employees from 2002 to 2008 by Carls et al. (2011) quantified the influence of weight loss or gain on medical expenditures. The results indicated that employees who moved into the high-risk obese category had a 9.9% higher increase in costs compared to those that stayed in the low risk category, while employees who moved from the high risk to low risk had only a 2.3% increase in costs compared to employees who remained at high risk (Carls et al., 2011). These results indicate that preventing weight gain and achieving sustained weight loss over the long term is likely to result in cost savings. Effective employer supported weight-management interventions may help control long-term costs associated with overweight and obesity in the workplace.

Theory-Based Weight Loss Programs

A limitation of the literature on nutrition, exercise, and weight loss interventions addressing overweight and obesity in the workplace is the lack of discussion of a theoretical basis or determination of the influence of theoretical constructs to outcomes. Hutchinson and Wilson (2011) considered the theoretical approach to such interventions in the calculation of effect sizes in a meta-analysis of 29 studies. They found that interventions using a cognitive-behavioral or motivational enhancement approach appear to be more promising (Hutchinson & Wilson, 2011). Cognitive-behavioral strategies for weight management may influence degree of self-efficacy (SE), confidence in ability to perform a behavior (Bandura, 1994), and the use of self-regulation (SR), using self-reflection strategies to influence behavior and motivation (Bandura, 1991).

In addition, Anderson et al. (2009) proposed a conceptual framework for developing health promotion programs in the workplace. This framework integrates aspects of multiple health behavior theories with an apparent focus on constructs of Social Cognitive Theory (SCT). The framework includes the influence of environment, behavior, and personal decisions in its design (L. M. Anderson et al., 2009). The interactions of these three components form the basis of SCT.

SCT is one of the most studied health behavior theories when it comes to weight loss or weight management. Namely, the available literature focuses on the constructs of SE and SR. SE and SR for weight management behaviors are important factors for weight loss outcomes identified in settings other than worksite based interventions (Annesi, 2011a; Annesi, 2011b; Annesi, 2011c). Worksite weight loss intervention programs may benefit from a theory based approach and the evaluation of SE and SR for weight management behaviors.

Social Cognitive Theory

Social Cognitive Theory attempts to explain peoples' behavior based on the interactive relationship between environmental, behavioral, and personal influences (McAlister, Perry, & Parcel, 2008). Recognizing the influence of environment, SCT emphasizes the individuals' ability to create an environment better suited to their needs. The theory also considers the influence of social groups on individual behavior and ability to illicit change in the environment. Determinants of behavior within SCT fall into five main categories that include psychological, observational learning, environmental, SR, and moral disengagement. The construct of SE, the confidence one has in being able to perform a behavior to achieve a desired outcome, outcome expectations, the result expected after performing the behavior, and collective efficacy or social support, ability of a group to bring about a behavior or outcome, fall within the psychological category. The construct of incentive motivation, use of rewards to encourage a desired behavior, falls under the environmental category along with facilitation, which involves the provision of tools and resources to enhance likelihood of behavior change. Observational learning, watching and learning from others, and self-regulation, which includes activities such as self-monitoring, goal setting, self-rewards, are constructs all of their own (McAlister et al., 2008). Use of these constructs is common in weight management efforts. The key constructs found to relate to successful weight loss, healthier nutrition choices and greater level of physical activity include self-efficacy, self-regulation, and social support.

Self-efficacy. Perceived SE as described by Bandura (1994) is determined by whether or not a person believes he or she can achieve a certain level of performance for a behavior that may have some bearing on an aspect of his or her life. One's degree of SE for the behavior will influence how he or she thinks, feels, motivation level, and what he or she actually does. For example, an individual with a strong belief that he or she can eat fewer calories from sugary foods to achieve weight loss, will be more likely to attempt eating fewer sugary foods, have higher motivation to do so, think and feel more positively about making the behavior change, and be more likely to accomplish it. The effort the person makes relates to his or her confidence in his or her ability to achieve the behavior and his or her expectation of what will happen as a result. Putting a high value on the expected outcome strengthens the effort as well. A strong sense of SE is associated with greater commitment and effort to achieve challenging goals even when faced with obstacles such as easy access to sugary foods. People with higher SE generally have greater resilience to setbacks, and will generally persevere through barriers. A poor perception of SE is associated with weak effort and giving up easily. For example, someone with low SE may easily give in to eating a donut but rather than accepting the setback and moving on, he or she gives up on any effort, eats the rest of the box of donuts, and experiences negative thoughts as a result. Therefore, low SE for changing eating behaviors is not likely to support weight loss success.

Skill building, role modeling, social persuasion, and positive emotions are tools to enhance SE (Bandura, 1994). Keeping with the example above, learning new ways to substitute sugary foods with healthier choices such as replacing sweet tea with fruit flavored tea without sugar will help build SE. Rather than replacing all sugary foods at once, an easily applied small goal is recommended. New health behavior goals and skills should be challenging yet attainable in order to achieve early progress. Small successes lead to increasing SE for the new behavior over time.

Observing successful role models seen as being similar to the individual also increases SE and effort toward new health behaviors. It instills the sense that if someone resembling me is able to do it then I can do it too. However, if the observer has low SE for the modeled behavior or puts a low value on the benefits of the expected outcome, behavior change is unlikely. To increase probability of success, the observed behavior can be broken down into smaller steps to allow mastery of the skills needed to achieve it.

Another tool to enhance SE is social persuasion, a form of social support. Helping the individual to believe in him or herself by stating a belief in his or her ability to achieve can increase desire to try harder to make the behavior change. Lastly, positive emotions lead to positive thinking and self-talk that strengthens SE and motivation for the new behavior. These ways of building SE incorporate components of SR of behaviors.

Self-regulation. SR is the ability to control, influence, or manage one's thoughts, feelings, motivations, and actions. It incorporates SE because SE influences thoughts, motivation, action, and reactions. Use of SR skills influences SE and SE influences use of SR (Bandura, 1991). Achieving SR encompasses self-monitoring, goal setting, feedback, self-reward, self-instruction, and social support (McAlister et al., 2008). Keeping food records is a form of self-monitoring that assists in developing awareness of eating behaviors or cues that may result in undesirable outcomes such as poor food choices and weight gain. Reflecting on results of self-monitoring provides a baseline for goal setting for new eating behaviors and for determining progress. Setting goals is a way to track and evaluate change in a behavior and influence action for a behavior. The act of goal setting encourages effort toward meeting a desired goal. A lack of goals results in little if any motivation to change. To give an example, if one has a desire to lose weight and through self-monitoring identifies that he or she frequently consumes high calorie sugary drinks, he or she can set an incremental goal to decrease intake of sugary drinks to promote weight loss. The initial goal might be to replace one sugary drink per day with a non-sugared drink. Meeting the goal is an indicator of mastering the skill of replacing sugary drinks and helps build SE. This skill mastery leads to a more challenging goal that can aid in reaching the desired weight loss goal. Having a high degree of SE is associated with more challenging goal setting and further enhances effort. Additionally, seeing progress toward the goal positively affects SE.

Obtaining feedback on how well the individual is performing the new behavior of decreasing sugary drinks is an important piece of SR. Feedback helps to determine if strategies for the behavior change are working or need altering. Positive feedback supports SE. Indications of poor performance for the new behavior can diminish SE and effort toward the desired outcome. Focusing on the positive changes even if they are small will help to maintain SE and effort, whereas dwelling on the negative will result in discouragement and giving up.

Continued monitoring and record keeping for feedback helps to identify small accomplishments along the path to a new behavior. Recognizing and rewarding these accomplishments increases effort for achieving the goal. Tangible or intangible self-rewards promote motivation for the new behavior (Bandura, 1991). For some the satisfaction of knowing they are consuming less added sugars may be rewarding enough while others may be more motivated by a decrease on the scale and reward themselves with a new pair of shoes for reducing sugar intake.

Next, self-instruction or self-talk is a form of SR. Self-instruction is the voice heard inside our head that guides us to attempting the new health behavior or in some cases not doing the behavior. Positive self-talk is associated with greater SE and motivation for performing the new health behavior. Practicing self-instruction for a new behavior may help people get through difficult situations. An example of this would be practicing phrases one could use to refuse politely the offering of a sugary drink or practicing the self-talk needed to make a decision when faced with the choice of choosing sweet tea or unsweetened tea.

Finally, recruiting the help and encouragement of others provides the individual making the change with social support that inspires SR. Verbal persuasion is a form of social support that involves others making positive comments about the individual's ability to succeed and positive progress toward the new behavior. Social support can also come in the form of helping to alter the environment in a way that supports the new behavior. Staying with the sugary drink example, this can include removing sugary drinks from the home or workplace and replacing them with non-sugared drinks. Social support enhances SE and SR for a health behavior.

SCT and Prediction of Health Behaviors

Food and nutrition choices. Anderson, Winett, and Wojcik (2007) argue that the availability of healthy foods and knowledge of how nutrition affects body weight and risk of disease is not enough to result in making better choices. Using a sample of 712 churchgoers, they evaluated how constructs of SCT related to people's food purchases and nutritional intake. They found that constructs of SCT could explain 35% of the variance in fat intake, 52% of fiber intake, and 59% of fruit and vegetable intake. The most important influencers of nutrition choices included age, gender, socioeconomic status, social support, SE, negative outcome expectations, and SR. Social support was an important precursor to SE. If social support was perceived as greater, participants made better nutrition choices and had greater SE. Higher SE was associated with increased fiber, fruit, and vegetable intake (E. S. Anderson, Winett, & Wojcik, 2007).

A later study by this group found higher SE to be associated with lower fat intake but not fiber, fruit, or vegetable intake (Anderson-Bill, Winett, & Wojcik, 2011). Outcome expectations were also important and influenced by SE. Negative outcome expectations were associated with poorer food choices, while positive outcome expectations did not appear to have an effect on nutrition behaviors. Using SR strategies was the best predictor of nutrition related behavior in this study. Application of SR behaviors is greater when SE and positive outcome expectations are greater. The authors concluded that SE is the primary determinant of nutrition behavior as it promotes positive outcome expectations and decreases negative outcome expectations while also supporting the use of SR strategies. However, SR surpasses SE when healthy choices are readily available, but one must choose between making the better or lesser choice. If one has high SE for making the healthier choice, ability to SR will influence the final decision (E. S. Anderson et al., 2007).

SE and weight loss. SE for eating (SE-eat) and exercise behavior has been evaluated as a determinant of weight loss with inconsistent results. Two short-term weight loss interventions measured baseline SE-eat and concluded that it did not predict weight loss outcomes (Byrne et al., 2012; Fontaine & Cheskin, 1997). In contrast, other studies have found baseline SE-eat to be associated with greater likelihood of achieving weight loss at the time of treatment (Anderson-Bill et al., 2011; Prochaska & Norcross, 1992; Shin et al., 2011; Warziski, Sureika, Styn, & Burke, 2008), but not at follow-up (Linde, Rothman, Baldwin, & Jeffrey, 2006). Three studies found SE for both eating and exercise to be associated with weight change (Annesi & Gorjala, 2010; Annesi, 2011c; Linde et al., 2006) and SE for eating and exercise predicted performance of weight control behaviors (Linde et al., 2006). Specifically, Annesi (2011c) showed that as SE for controlled eating increased in a 26-week community-based weight loss intervention, participants improved their intake of fruits and vegetables and increased amount of exercise. Improvements in fruit and vegetable intake and amount of exercise predicted success with weight loss (Annesi, 2011c). Moreover, the majority of studies support SE for eating and exercise as an influencing factor in short-term weight loss outcomes and therefore focusing on strengthening SE in weight management interventions may lead to better outcomes.

Few studies have measured change in SE for eating and exercise and considered the predictive power. SE for eating and exercise can improve significantly during weight loss interventions (Palmeira et al., 2007; Warziski et al., 2008). Palmeira et al. (2007) concluded that health behavior models including SE as a variable significantly predicted weight change, and change in SE for eating and weight management was the single best predictor of weight loss. In contrast, Byrne et al. (2012) found that change in SE for exercise was a stronger predictor of weight loss than change in SE for diet.

SR and weight loss. In contrast to the findings above, Cahill, Freeland-Graves, Shah, Lu, and Pepper (2012) found increased dietary restraint to be the most significant predictor of weight loss in an 8-week intervention for weight loss in low income, post-partum women. Decrease in total energy intake was the second best predictor of weight loss. The intervention drew on SCT as a theoretical basis using the broad categories of behavioral, personal, and environmental constructs. SR behaviors for dietary restraint and energy intake fell within the behavioral category and included self-monitoring and stimulus control behaviors. SE for weight loss did predict weight loss alone but did not affect the model. Also, increased use of behavioral weight management skills and decreased discretionary calorie intake each predicted weight loss separately but did not affect the model. Overall, the SR behavioral changes resulted in the greatest reductions in weight (Cahill et al., 2012).

Evidence suggests that weight loss is dependent on SR of behaviors that decrease energy intake or increase energy expenditure or a combination of both. Self-monitoring of weight, food intake, and physical activity are frequently used methods of SR for weight management. Use of self-monitoring of the above mentioned behaviors predicted weight loss outcomes and acted as a mediator of weight loss in overweight and obese adult subjects who were mostly female (Kong et al., 2012; Turk et al., 2013). Additionally, daily self-monitoring of weight is associated with increased weight loss and increased use of weight loss behaviors such as reducing portion sizes, eating out less often, reducing snacking, and increasing exercise in overweight and obese men and women (Steinberg, Bennett, Askew, & Tate, 2015). Use of SR behaviors that result in positive outcomes may increase motivation and SE for other weight loss promoting behaviors.

Three studies showed change in the use of SR skills for eating and exercise was associated with SE for eating and exercise, which in turn was associated with weight change (Annesi & Gorjala, 2010; Annesi, 2011c; Linde et al., 2006). Linde et al. (2006) showed greater use of SR for weight loss behaviors mediated the effects of SE for eating on weight change and was a better predictor of weight change than SE (Linde et al., 2006). In addition, use of SR skills and SE for exercise can mediate SR and SE for eating behavior (Annesi, 2011a). This implies confidence for exercise and the ability to maintain regular exercise may lead people to improve eating behavior. Moreover, greater use of SR behaviors is associated with higher levels of SE for diet and exercise behavior and overall weight loss (Annesi, 2011c; Rejeski, Mihalko, Ambrosius, Bearon, &

McClelland, 2011). More studies are needed to evaluate the impact of worksite-based weight loss interventions on SR and SE for both diet and exercise related weight loss behaviors as the studies reviewed here were conducted in other community-based settings that may have influenced outcomes.

Social Influence and Support for Weight Loss

In addition to SR and SE, social influence and support within social networks influences body weight and weight loss success. Social influence occurs when the actions of those around you affect what you think and do and social support is receiving help and encouragement from relationships with those around (Heaney & Israel, 2008). Overweight and obesity tends to cluster within social networks (Christakis & Fowler, 2007; Leahey, LaRose, Fava, & Wing, 2011). Christakis and Fowler (2007) evaluated 30 years of data collected longitudinally from the offspring of the Framingham Heart Study cohort and found that individuals were 40% more likely to become obese if one sibling was obese, 37% more likely to be obese if a spouse was obese, and 57% more likely to be obese if a friend was obese. Influences of social ties were greater among those of the same gender. Geographical networks were not associated with social influence (Christakis & Fowler, 2007). Similarly, BMI among young adults 18-25 years old is related to social influence. Young adults who were overweight or obese were more likely to have an overweight romantic partner or best friend, and more friends and family members that are overweight compared to non-overweight individuals. Additionally, overweight and obese persons had greater intentions to lose weight when they had more social contacts trying to lose weight (Leahey et al., 2011). These studies demonstrate the importance of social influence and support among social networks.

Social influence and support affect weight management behaviors and weight loss. One study found participants in a weight loss program who had a social contact who participated in the same program were more likely to be influenced to enroll, attended more sessions, had greater use of self-monitoring, and lost significantly more weight (Carson et al., 2013). Participants are more likely to be successful with weight loss when the social contact attending the program with them also loses weight (Gorin et al., 2005). Similarly, in a study that evaluated the influence of teammates and social influence on individual weight loss within a team-based weight loss intervention, researchers found greater weight loss associated with greater social influence and a higher number of teammates also trying to lose weight (Leahey, Kumar, Weinburg, & Wing, 2012). When people are working at weight loss together, social influence may help promote greater outcomes. Participants in weight loss programs can also influence spouses and the home environment, leading to weight loss in individuals not enrolled in the weight loss program (Gorin et al., 2008).

Furthermore, Anderson-Bill, Winett, and Wojcik (2011) found perceived social support predicted nutrition and physical activity behaviors among users of a web-based weight loss intervention. Greater perceived social support was also associated with greater use of SR behaviors for physical activity but did not affect SE for physical activity. SE and SR for eating behaviors mediated the effects of social support on dietary intake. Higher perceived social support was associated with lower fat intake and higher fiber, fruit, and vegetable intake (Anderson-Bill et al., 2011). Social influence and support can play a beneficial role in encouraging behavior change leading to weight loss. Weight loss interventions should considered means of incorporating social support and influence.

Only a few studies have evaluated co-worker social support related to weight loss, physical activity, and diet behaviors within worksite based interventions. High worksite social support was associated with a 14.3% higher physical activity score and a 4% higher fruit and vegetable score, but was not related to BMI in one study (Tamers et al., 2011). Among school employees participating in a weight gain prevention program, co-worker and friend support for healthy eating and family support for physical activity was associated with greater weight loss at 24 months whereas social undermining by family members led to weight gain (Wang, Pbert, & Lemon, 2014). Female hospital and nursing home employees who enrolled as a group in a worksite weight loss program had significantly greater decreases in weight, body fat, and BMI compared to those who enrolled as individuals (Rigsby, Gropper, & Gropper, 2009). Worksite weight loss interventions that include and encourage social support from co-workers will likely lead to better outcomes for weight loss, physical activity, and nutrition related behaviors.

Qualitative Findings of Social Influence and Support

The role of social influence and support is largely supported by quantitative data. Few qualitative studies exist to provide insight into how social support and influence affects weight management related nutrition and physical activity behaviors. Bishop et al. (2013) evaluated how participants of a weight loss and diabetes prevention program perceived their influence on non-participant social support persons. Three themes of social influence were identified. Participants believed that they influenced their social support persons to make lifestyle changes, increase knowledge, and motivation. The more favorable perception of changes in social support persons eating behaviors correlated with greater weight loss in participants (Bishop et al., 2013). Participants may see themselves as role models, which may have led to positive outcomes, but was not addressed in the study findings.

In another qualitative study, a theme that emerged was that social networks could be both positive and negative experiences. Participants reported receiving advice about dieting from friends or family members or other social networks. Although they often felt supported by "diet groups", they also found that sometimes these groups were a source of decreased self-esteem, shame, and negativity. They reported feeling guilty if they lost more weight than others did, or shame if they did not have success with weight loss. Additionally, family and friends comments about their weight loss sometimes made them feel uncomfortable. Comments about thinness and looking sick were unsupportive and dieters felt that friends and family might be sabotaging their effort to lose and maintain weight loss. Despite the negative experiences, most still desired support for diet and exercise behaviors (Thomas, Hyde, Karunaratne, Kausman, & Komesaroff, 2008).

This desire for social support was evident in findings from a study evaluating the attitudes, beliefs, and knowledge of obese individuals conducted among women living in rural Kansas. Ely, Befort, Banitt, Gibson, and Sullivan (2009) conducted six focus groups with 31 women. Themes emerged from the focus groups that indicate a desire for social support with weight loss efforts. First, participants believed that primary care physicians should provide more support. They largely felt that their primary care providers were not supportive in encouraging weight loss, and that primary care offices would be a good location to provide resources for weight loss such as weight control programs and exercise programs. They felt there was a lack of resources available to encourage dietary changes while there were adequate resources to support increased physical activity. They commented on the lack of places to eat that offered healthy foods and desired restaurants to add greater number of healthful items to their menus. Another theme demonstrated a clear need for intensive weight management programs within their communities. Most would have to travel several miles to take part in a weight loss program. Lastly, the women reported a need for group support, motivation, professional guidance, and accountability (Ely et al., 2009). Individuals with overweight and obesity desire social support. Positive social support networks may help empower individuals to make healthful food choices and encourage physical activity.

Implications for Interventions

Based on the studies discussed above, it is evident that interventions based on constructs of SCT can support weight loss success. Intervention programs that focus on self-regulation and building self-efficacy for desired behavior changes are likely to lead to positive weight changes and eating and exercise behaviors at least in the short-term. Social support and influence are apparent factors important for increasing use of self-regulation behaviors, supporting self-efficacy, and possibly increasing motivation.

Therefore, programs should consider how to incorporate strategies to enhance social support and influences within weight management programs.

Efficacy of Short-term Weight Management Interventions in the Workplace

Short-term workplace interventions that address overweight and obesity can have modest, but significant effects on weight loss and cardiovascular related risk factors. The majority of studies consist predominantly of overweight and obese females with only one study including males only. Short-term interventions ranging from 8 to 14 weeks have resulted in a mean weight loss ranging from 1.6 kg to 4.0 kg and showed small decreases in BMI. All short-term studies evaluated here also showed reductions in waist circumference (Christensen et al., 2011; Morgan et al., 2011; Rigsby et al., 2009; Thorndike, Healey, Sonnenberg, & Regan, 2011; Touger-Decker et al., 2008). Studies measuring percent body fat found small but statistically significant reductions (Christensen et al., 2011; Rigsby et al., 2009; Touger-Decker et al., 2008). Four studies evaluated the effect of the workplace intervention on blood pressure and found significant reductions in both systolic and diastolic blood pressures (Christensen et al., 2011; Morgan et al., 2011; Thorndike et al., 2011; Touger-Decker et al., 2008). Touger-Decker et al. (2008) and Thorndike et al. (2011) both measured the effect of a 12 and 10-week intervention on total cholesterol, respectively. At 10-weeks, cholesterol had decreased in all participants regardless of BMI (Thorndike et al., 2011). In the 12-week intervention, mean total cholesterol of 194.3 mg/dL at baseline decreased to 183.2 mg/dL (Touger-Decker et al., 2008). Touger-Decker also evaluated the influence of the intervention on blood glucose; an indicator of type 2 diabetes commonly associated with obesity and found no significant change. Although these results were small and questionably clinically meaningful, they do show trends in the right direction for decreasing overweight and obesity along with obesity-related CVD risk factors with short-term interventions.

Two short-term interventions included evaluation of changes in nutrition and exercise habits based on self-report. Touger-Decker et al. (2008) reported that participants increased fruit and vegetable intake, decreased consumption of sweets, and focused on portion control. Morgan et al. (2011) found that the intervention resulted in positively influencing physical activity and decreased intake of sweetened beverages, mainly sodas, but did not affect other nutrition variables. Short-term interventions therefore have the power to impact nutrition and exercise habits important for achieving healthier body weights and promoting overall health in the workplace. None of the studies reviewed in this section described a theoretical underpinning of the workplace intervention. This may partially explain the limited and modest results of such interventions. Future research should incorporate a theoretical basis and methods of measuring nutrition and physical activity changes to better assess the potential of influencing these behaviors in workplace interventions.

Conclusion

In conclusion, constructs of SCT help to predict weight loss associated with weight management interventions. Constructs of particular interest and best predictability for weight loss include self-efficacy, self-regulation, and social support. Nutrition and physical activity intervention studies addressing overweight and obesity in the workplace lack discussion of a theoretical basis and evaluation of theoretical constructs and outcomes. Short-term interventions in the workplace have demonstrated effectiveness in achieving small changes in body weight and eating and physical activity behaviors. It is unclear as to whether or not more clinically meaningful weight loss is achievable and will result in long-term improvement in health outcomes and obesity with workplace interventions. Further research should focus on application of psychosocial constructs in the development and implementation of comprehensive lifestyle worksite-based weight loss interventions that focus on reduced energy intake, increasing physical activity, and behavior modification strategies for lifestyle change.

CHAPTER III

METHODOLOGY

This pilot study used a sequential mixed-methods design that included a quasi-experimental design to quantitatively evaluate the change in self-efficacy (SE) and (SR) for eating and exercise behaviors of an intervention group participating in a 10-week weight loss program compared to a control group. In addition, this study qualitatively explored the effects of social influence on SE and SR for eating and exercise behaviors among the intervention group. This study was approved by the Institutional Review Board of the University of Texas Southwestern Medical Center (UT Southwestern) and an Inter-agency Agreement was signed and approved by the Institutional Review Board of Texas Woman's University. The study included adult overweight and obese female employees of UT Southwestern who completed quantitative questionnaires as well as a sub-group of intervention participants who completed qualitative semi-structured interviews.

Population and Sampling

Female employees were recruited for participation in a 10-week worksite weight loss program, which is a component of the UT Southwestern campus wellness initiative. This is a first come, first served program that accepts approximately 30 volunteer participants per 10-week session. Participant recruitment strategies included an announcement in the weekly UT Southwestern campus update email and flyers posted throughout the campus. To be eligible to participate in this study, participants had to meet the following inclusion criteria: non-pregnant adult female, 20 years of age or older, employed by UT Southwestern, have a body mass index greater than 25 kg/m^2, willing to participate in a 10-week worksite weight loss intervention, and able to be physically active and consume food patterns consistent with the U. S. Dietary Guidelines, DASH diet, or Mediterranean Diet. Employees were excluded from the study if they had participated in a prior worksite weight loss program within the past six months.

Intervention Description

For this study, the intervention included 10 weekly 50-minute sessions based on a modified version of the Group Lifestyle Balance program developed by the Diabetes Prevention Program Lifestyle Resource Corp at the University of Pittsburgh. The researcher, an experienced registered dietitian nutritionist, licensed dietitian with education and training in lifestyle management, and certified group fitness instructor by the American Council on Exercise, delivered the intervention program sessions outlined in Table 3.1 (Appendix A). Instruction on goal setting and monitoring daily food intake, calories, total fat, daily physical activity, and weekly weight was included.

Table 3.1
Outline of Intervention Session Topics

Session 1: Welcome to the program: Setting your weight loss goal and monitoring food Intake
Session 2: Food label reading: Finding excess fat and calories
Session 3: Defining healthy eating: Using MyPlate and Dietary Guidelines
Session 4: Moving your muscles: Establishing your personalized exercise prescription
Session 5: Tipping the calorie balance in your favor
Session 6: Take charge of your surroundings: Setting up your environment for success and social cues
Session 7: Problem solving: Finding solutions to triggers and unexpected events
Session 8: Keys to making healthy decisions when eating out
Session 9: Slippery slope of lifestyle change: Dealing with setbacks and relapse
Session 10: Staying motivated for continued success

Screening and Consent

Upon initial email contact from interested participants, the primary investigator screened participants for eligibility and provided them with an explanation of the study, the written informed consent form, and HIPAA authorization form via email. Participants returned the signed consent and HIPAA form by campus mail to confirm a space in the intervention group. The first 64 eligible participants who provided written consent and HIPAA authorization made up the intervention group. Additional eligible participants who provided written consent and HIPAA authorization were assigned to the control group. Study eligibility was confirmed at the first weigh-in measurement. The primary investigator provided participants with a copy of their signed consent form.

Room availability, capacity, and campus location limited the number of participants entered into the study. The goal was to have more than 30 participants in both the intervention and control groups to achieve an adequate sample size for quantitative statistical calculations and comparisons. Three intervention group 10-week sessions were offered with staggered start dates, on different days of the week and at campus locations to assure adequate numbers of intervention participants. This allowed for enhanced recruitment, manageable group sizes, and for social interaction among the group members. Too large of groups may negatively affect the ability to manage group interaction.

Selection of Participants for Qualitative Interviews

Twelve participants from the intervention group were purposefully selected to participate in qualitative semi-structured interviews at the completion of the 10-week intervention program. Participants who reported on the demographics questionnaire that they were encouraged to participate in the program by a friend or co-worker and were attending the program with a friend or co-worker were selected. These participants also indicated that they were willing to participate in an interview about their experiences and social influences on eating and physical activity habits.

Protection of Human Participants

Strong efforts were made to protect participants from potential harm. To protect participants from harm due to loss of confidentiality, personal information was not included in email communications and each participant received a study identification number. Assessment tools and files used the assigned number in place of the participants' names. The master list of participant names and emails was accessible to the researcher only on a password protected computer drive. Any written identifiable data was kept separate from participant files in a locked file drawer in the researcher's office. Written identifiable information will be shredded within a year of the study completion. In addition, study participants in the group intervention sessions were asked and reminded to avoid discussing personal information with others outside of the class sessions.

To protect participants from potential harm due to emotional discomfort, participants were told that they were not required to engage in discussion or respond to questions that make them uncomfortable. They were advised to talk with a qualified professional about any discomfort they were experiencing. The researcher provided participants with contact information for the employee mental health assistance program.

To protect participants from potential harm due to embarrassment, weekly weight measurements for the intervention group were taken one at a time at the back of the room away from other participants. Individual weight recording sheets were used and placed in a three-ring notebook accessible only to the researcher. The notebook was stored in a locked file drawer in the researcher's office when not in use for weekly recording to protect confidentiality.

Potential harm due to increasing physical activity was minimized by asking intervention participants to complete the Physical Activity Readiness Questionnaire (PAR-Q) as recommended by the Exercise is Medicine initiative supported by the American College of Sports Medicine during the intervention session on physical activity. Intervention participants were advised to consult with their doctor if risk factors were identified. In addition, they were instructed on safe ways to become more physically active such as starting off slowly, increasing duration instead of intensity, doing activities they are familiar with such as walking, wearing appropriate clothing, and recognizing signs to stop exercising such as lightheadedness or chest pain and discomfort. They were advised to consult with their doctor if they experienced any negative side effects of increasing physical activity.

Lastly, to minimize the harm of consuming a diet pattern too low in calories and essential nutrient intake, intervention participants were instructed to follow an appropriate calorie goal determined by the researcher, a registered dietitian nutritionist and licensed dietitian, that allows for a safe rate of weight loss of one to two pounds per week. No participant was advised to consume less than 1200 calories per day, which is consistent with current weight management recommendations. In addition, participants were advised to choose foods from all food groups to assure adequacy of nutrients and ability to meet the Dietary Reference Intakes for macronutrient distribution and micronutrients. Participants were advised on the healthiest choices to make within each food group and appropriate portion sizes as indicated by the U.S. Department of Agriculture's MyPlate guidelines to assure adequacy and variety of nutrient intake.

Data Collection Procedures

Quantitative Procedures

Quantitative study questionnaires were completed using an online web-based form at weeks 1, 10, and 14 (4-week follow-up after completion of the intervention). Participants received their study identification number and a hyperlink for accessing the questionnaires via personal email from the primary investigator. Intervention group participants completed the demographics questionnaire at week-1 only, and the control group completed a modified version of the demographics questionnaire without the questions pertaining to social influence at week-1 only. Both groups completed the study questionnaires online for self-efficacy and self-regulation for eating and exercise, fruit and vegetable screener, and frequency of physical activity at weeks 1, 10, and 14. Participants received an incentive of a five-dollar value for each questionnaire set completed.

For both groups, self-reported height was recorded to the nearest half inch and weight was measured and recorded (see Appendix B for participant recording sheet) in pounds to the nearest hundredth in regular street clothes without shoes, and minus two pounds for clothing using a portable digital scale (Tanita TBF-310GS). The control group's weight was measured at pre-determined campus locations during weeks 1, 10, and 14 and body mass index (BMI) was calculated and recorded, respectively. For the intervention group, weight was measured and recorded at the beginning of class sessions during weeks 1 and 10 and at specified campus locations at week-14 for follow-up. Weight was recorded weekly using the same protocol and scale at the weekly intervention session locations during weeks 2 through 9.

Qualitative Procedures

Twelve intervention participants were purposefully selected for the qualitative interviews based on responses to questions on the demographics questionnaire pertaining to whether or not they were participating in the program because of or with a friend or co-worker and willingness to participate in an interview. Eleven semi-structured interviews were scheduled and conducted over the employees lunch hour or other convenient time in the workday during weeks 11 and 12 following completion of the 10-week weight loss intervention. Interviews took approximately 45 minutes. Prior to beginning the interviews, participants received a scripted explanation of the purpose for the interview, instructions, and asked for verbal permission to audio record their responses. Participants responded verbally to 11 semi-structured, open-ended questions asked in the same order by the researcher for each interview. The researcher prompted participants to provide examples and further thoughts when appropriate to clarify meaning of responses and perspectives of experiences. The researcher took hand written notes in addition to audio-recording interviews using an MP3 audio recorder.

Instrumentation

Demographics Instrument

A short demographic instrument was administered to characterize the study participants, including questions pertaining to social influence and previous weight loss attempts (Appendix C). Participants for semi-structured interviews were selected based on responses to questions 8 through 10.

Quantitative Instruments

The eight-item validated Weight Efficacy Lifestyle Questionnaire short-form (WEL-SF) was used to measure self-efficacy for eating (SE-Eat) behaviors related to weight management (Ames, Heckman, Grothe, & Clark, 2012). The WEL-SF is based on the commonly used and validated 20-item WEL questionnaire (Clark, Abrams, Niaura, Eaton, & Rossi, 1991). The total WEL-SF score and WEL score are highly correlated, r = .986 and r^2 = .937. The items of the WEL-SF (Appendix D) provide a total score of the ability to resist eating related to negative emotions, food availability, and social pressure. Participants rated their ability to resist eating in difficult situations using a Likert scale of 0 to 10 points. The WEL-SF was chosen to reduce response burden and time for completion (Ames et al., 2012).

The 13-item validated Physical Activity Assessment Inventory (PAAI) was used to measure self-efficacy for physical activity (SE-PA) (Appendix E). Participants rated their ability to perform their usual physical activities under certain conditions that may be perceived as barriers. The PAAI is based on commonly used and validated existing self-efficacy scales for exercise. The PAAI addresses a broad definition of physical activity (activity at work, home, and leisure) as opposed to the subset of structured exercise only. Reliability was previously determined using Cronbach alpha, .95, among a sample of adult women. Results are significantly correlated with a previously validated and reliable exercise self-efficacy scales, $r = .54$, $p < .01$, and with reported activity level, $r = .33$, $p < .01$ (Haas & Northam, 2010).

Self-regulation for eating (SR-Eat) behavior was measured using a scale adapted from an existing scale previously tested for predictive validity and reliability. The adapted scale showed an internal consistency and test-retest reliability of .8 and .74 respectively in a severely obese population. Participants rated the frequency of self-regulating behaviors for eating from 1 (never) to 4 (often) on 10 items (Appendix F) (Annesi, 2011b).

Self-regulation for physical activity (SR-PA) behavior was measured using a 14-item scale (Appendix G) adapted from previously developed scales (Dishman et al., 2005; Saelens et al., 2000a; Umstattd, Motl, Wilcox, Saunders, & Watford, 2009). Umstattd et al. (2009) found a 12-item SR-PA scale to be valid among an older adult population. Saelens et al. (2000) measured SR-PA in a group of senior level college students using a 14-item scale designed to be consistent with behavioral and cognitive strategies addressed in the intervention as recommended from previous studies. It is recommended that the scale items used be adapted to match the components of the intervention (Saelens et al., 2000a). Using the adapted scale, participants rated their frequency of self-regulating behaviors for exercise from 1 (never) to 4 (often) on 13 items. A total score was calculated.

The two-item cups of fruits and vegetables screener (2-CUP FVS) questions from the National Institutes of Health Food Attitudes and Behavior survey was used to measure estimated fruit and vegetable intake (Appendix H). The screener provides participants with examples of portion sizes and asks them to indicate the amount in cups of fruit and vegetables (either whole or 100% juice) they eat or drink each day. Short screeners are considered appropriate for gross estimates of fruit and vegetable intake when time constraints and respondent burden must be considered (Yaroch et al., 2012).

The six-item exercise frequency questionnaire available from the Stanford Patient Education Research Center was used to measure frequency of exercise behaviors (Appendix I). Participants are asked to estimate the total time spent during the past week on certain exercise activities. Previous test-retest reliability for survey item one measuring frequency of strengthening and stretching exercise was .56 and for items 2 to 6 combined measuring aerobic activity was .75 (Lorig et al., 1996).

Qualitative Instrument

Lastly, the primary investigator conducted semi-structured interviews in person using a set of pre-established open-ended questions developed for this study (Appendix J) to understand social influences of co-workers or friends on SE and SR of weight management eating and exercise behaviors. Participants for interviews were selected based on positive responses to questions 8, 9, and 10 of the demographic questionnaire.

Data Analysis

Quantitative Analysis

IBM SPSS Statistics 22 was used for quantitative data analysis. Descriptive statistics and independent *t*-tests were conducted for analyzing and comparing participant characteristics (age, weight, BMI, prior weight loss, SE, and SR), program attendance, and completion rates. Repeated measures mixed analysis of variance (ANOVA) evaluated within-subjects and between-subjects mean differences at week 1, 10, and 14 for the dependent variables: weight, BMI, SE-Eat, SE-PA, SR-Eat, SR-PA, CUP FVS, and exercise frequency. Pearson's correlation coefficients evaluated magnitude and significance of relationships of SE and SR of eating and exercise to weight change, fruit and vegetable intake, and exercise frequency.

Qualitative Analysis

Audio recordings of interview data were transcribed verbatim into an electronic document for content analysis using QSR NVivo 10 qualitative analysis software for coding and organizing data. The researcher reviewed transcripts for accuracy and coded key words, phrases, or sentences using one or two words. Coded data were reviewed for redundancy, relationships, and organized by similarities. Coded data were organized into sub-themes within overarching themes of SE and SR along with direct participant quotes that supported each sub-theme. A combined deductive and inductive reasoning approach was used to identify themes. Existing literature on social influence and social support and the current data informed the identification of overarching and sub-themes. Based on theories of social support and social influence, the assumption was that people who attend the program because of the influence of a friend or co-worker or attend with a friend or co-worker are more likely to have positive outcomes and experiences, and greater change in the dependent variables being measured quantitatively. Qualitative findings were compared to quantitative findings to determine consistency of findings between both sets of data.

Summary

This was a mixed methods study using a quasi-experimental design to compare quantitative measures of SE and SR for eating and exercise, fruit and vegetable intake, and exercise frequency among female employees in a weight loss intervention group to a waitlist control group. Semi-structured interviews were conducted to gather qualitative data to explore the effects of social influence on SE and SR for eating and exercise behaviors among the intervention group. Quantitative data were analyzed to determine differences between the intervention and control groups and the effects of the weight loss intervention on the dependent variables. Qualitative data were analyzed to identify themes related to the effects of social influence on the study variables.

CHAPTER IV

RESULTS

Contained within this chapter is a description of the quantitative and qualitative results of the study. Three study groups were implemented with staggered start dates and different campus locations to enhance participation in the study. Figure 4.1 illustrates the total number of participants at each stage of the study. Ninety-six female participants completed the study consent form and the week-1 weigh-in at their respective start date and location. Fifty-eight participants made up the intervention group and 38 participants made up the control group at week-1. Forty-four of the intervention participants completed the final week-14 (4-week follow-up post week-10 intervention completion) questionnaire and weigh-in, however, only 41 (70.7%) had complete data sets for all measurement time points. At week-14, 32 (84.2%) participants of the control group completed both the questionnaire and weigh-in for all time points.

Quantitative Results

Quantitative data were analyzed using IBM SPSS Statistics 22. Baseline characteristics of the intervention and control groups are shown in Table 4.1. Independent-*t-tests* were run to compare the means between the groups on baseline measures of the dependent variables. Significant differences between the means were found at baseline for self-regulation of both eating, t (94) = 1.996, p = .05, and physical activity, t (92) = 1.953, p = .04; equal variances could not be assumed on the later. Participants in the control group had higher mean scores on self-regulation for eating behavior (M = 25.79, SD = 5.72) than the intervention group (M = 23.17, SD = 6.62). The control group also had higher mean scores on self-regulation for physical activity compared to the intervention group (M = 35.45, SD = 8.02 vs. M = 31.48 SD = 10.69). There was no significant difference between means on any other dependent variables at week-1, and no significant difference on any dependent variables at week-1 when analysis only included subjects with complete data sets at week-14.

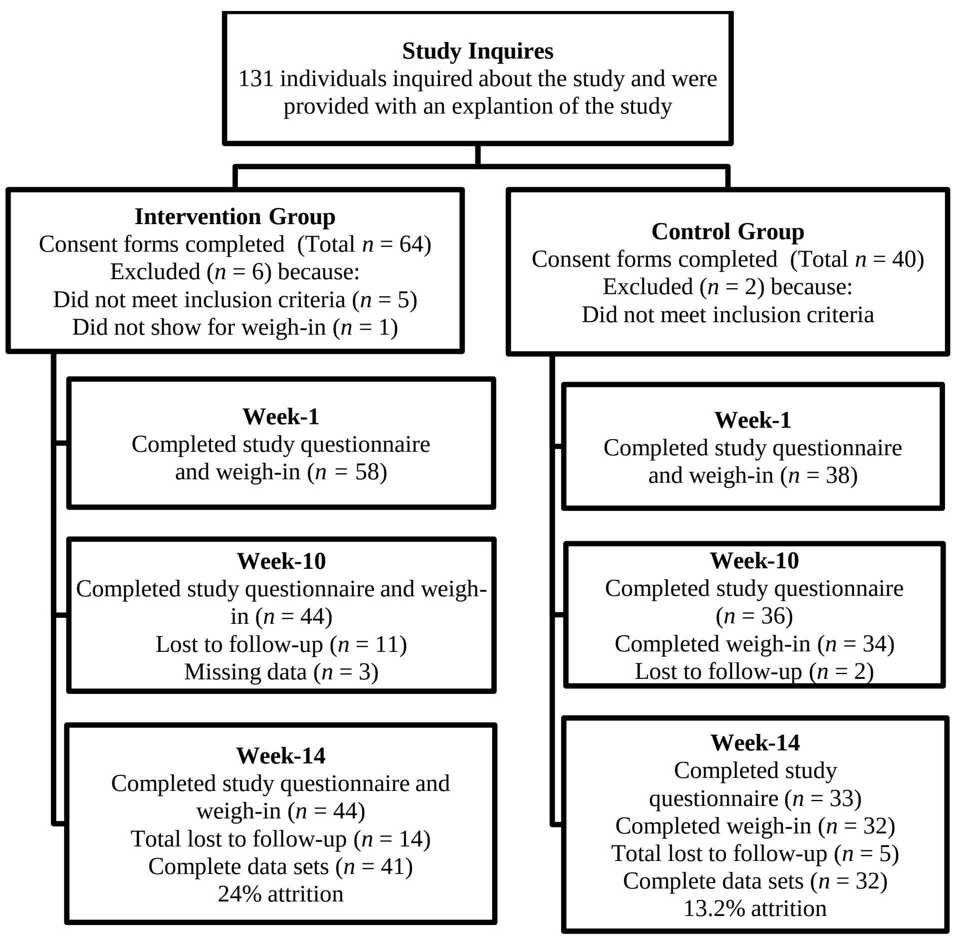

Figure 4.1: Flow of Participants through Stages of the Experiment

Table 4.1

Intervention and Control Group Characteristics Comparison of Means and Standard Deviations of the Sample at Baseline Week-1 (independent t-test)

Characteristic	Intervention (n = 58) *M* (SD)	Control (n = 38) *M* (SD)	*p*
Age	46.36 (10.42)	46.63 (10.33)	.90
Weight (lbs)	204.28 (38.89)	206.60 (42.57)	.78
Body Mass Index	34.99 (6.58)	34.92 (6.91)	.96
No. of friends overweight	8.60 (6.44)	9.95 (9.71)	.42
No. of friends trying to lose weight	4.12 (3.40)	4.84 (7.83)	.56
SE-Eat	45.00 (18.83)	43.13 (14.73)	.59[a]
SE-PA	627.07 (273.41)	690.26 (256.58)	.26
SR-Eat	23.17 (6.62)	25.79 (5.72)	.05*
SR-PA	31.48 (10.69)	35.45 (8.02)	.04[a]*
Fruit intake (cups/day)	1.07 (0.97)	1.28 (1.00)	.30
Vegetable intake (cups/day)	1.39 (1.06)	1.32 (0.79)	.70[a]
Strength/stretching exercise (min/week)	23.79 (46.68)	31.58 (50.39)	.44
Aerobic exercise (min/week)	110.43 (128.87)	138.16 (119.35)	.29

[a]equal variances not assumed

*$p \leq .05$, significant result

Table 4.2 summarizes the means and ranges for SE-Eat, SE-PA, SR-Eat, and SR-PA for the intervention group only at each measurement time point. Table 4.3 shows the comparison of participants reporting prior weight loss attempts in the intervention group compared to the control group. Fifty-five percent of the intervention participants and 50% of the control participants reported having attempted to lose weight in the past. Reported prior weight loss ranged from less than 5 to greater than 31 pounds. Of the intervention participants who reported prior weight loss, 28.1% previously lost 5 to 10 pounds and 25% had lost 31 pounds or more. Among the control, 36.8% reported losing 31 pounds or more. However, 72% of the intervention participants and 58% of the control participants regained the lost weight from prior attempts. Weight Watchers was the most commonly reported prior weight loss program attended by both the intervention (56%) and control (58%) group participants.

Table 4.2
Summary of Means and Standard Deviations with Ranges for SE and SR for Eating and Physical Activity Among Intervention Participants Only

Variable	Lowest to Highest Possible Score	Week-1 (n = 58)		Week-10 (n = 44)		Week-14 (n = 44)	
		M (*SD*)	*Ra*	*M* (*SD*)	*Ra*	*M* (*SD*)	*Ra*
SE-Eat	0 – 80	45.00 (18.83)	68	56.98 (15.07)	66	60.48 (12.92)	57
SE-PA	0 – 1300	627.07 (273.41)	1130	742.50 (267.16)	1170	838.64 (263.93)	1020
SR-Eat	10 – 40	23.17 (6.62)	29	29.75 (5.21)	19	29.45 (6.88)	27
SR-PA	13 – 52	31.48 (10.69)	38	36.66 (9.00)	37	38.00 (8.97)	34

Table 4.3
Intervention and Control Group Comparison of Participants Reporting Prior Weight Loss Attempts at Baseline Week-1 (frequencies)

Variable	Intervention (*n* = 32) *n* (%)		Control (*n* = 19) *n* (%)	
Prior weight loss (lbs):				
Less than 5	4	(12.5)	3	(15.8)
to 10	9	(28.1)	5	(26.3)
11 to 15	1	(3.1)	1	(5.3)
16 to 20	6	(18.8)	1	(5.3)
21 to 25	0		0	
6 to 30	3	(9.4)	1	(5.3)
31 or more	8	(25.0)	7	(36.8)
Did not lose	1	(3.1)	1	(5.3)
Kept lost weight off:				
No	23	(71.9)	11	(57.9)
Yes	8	(25.0)	7	(36.8)
Did not lose	1	(3.1)	1	(5.3)
Prior programs attempted:				
Weight watchers	18	(56.3)	11	(57.9)
Jenny Craig	7	(21.9)	2	(10.5)
Nutrisystems	5	(15.6)	2	(10.5)
Worksite weight loss program	2	(6.3)	4	(21.1)
Other	15	(46.9)	7	(36.8)

Attendance

Among the participants of the intervention group that completed all components of the study at week-14 (*n* = 41), the mean number of intervention class sessions attended was 6.98 (*SD* = 1.97) out of 10 sessions. Two (4.9%) participants had attended less than 3 class sessions, 15 (36.6%) attended 4 to 6 class sessions, and 24 (58.5%) attended 7 or more class sessions. Pearson's *r* tests were run to identify correlations among attendance and other dependent variables. Weak to moderate significant positive correlations were found between the number of class sessions attended and weight change from week-1 to week-10 of the intervention, r = .38, p = .02, R^2 = .14, and week-1 to week-14, r = .42, p = .01, *R2* = .18. Approximately 14% and 18% of the variance in weight change could be explained by the variance in class attendance, respectively. The greater number of class sessions attended correlated with greater weight loss. Weak but significant positive correlations were also found between the number of class sessions attended and improved self-regulation scores for eating at week-10, r = .35, p = .02, R^2 = .12, and for total minutes of aerobic exercise per week at week-10, r = .31, p = .05, R^2 = .10. This suggests dose of attendance has a small influence on these dependent variables.

Within and Between-Subjects Comparisons

A repeated measures within-subjects and between-subjects mixed ANOVA was conducted to evaluate the effect of time (week-1, week-10, week-14) and group (intervention vs. control) on weight, BMI, SE-Eat, SE-PA, SR-Eat, SR-PA, CUP FVS, and minutes per week of strength/stretching and aerobic exercise. The time main effect and time by group main effect were tested for each variable using Wilks's Lambda. Table 4.4 summarizes the results of the Mixed ANOVA tests.

Table 4.4

Results of Within-subjects and Between-subjects Mixed ANOVA for the Intervention and Control Group with Follow-up t-tests

	Intervention (n =41)			Control (n = 32)					
Characteristic	Week-1 *M* (SD)	Week-10 *M* (SD)	Week-14 *M* (SD)	Week-1 *M* (SD)	Week-10 *M* (SD)	Week-14 *M* (SD)	*Time effect p*	*Time x group effect p*	*Between subjects effect p*
Weight (lbs)	201.69	199.22**	197.59$^{**!}$	206.65	207.36	206.95	.01$^{a\#\#}$	.00$^{a\#\#}$	.44
	(36.91)	(38.34)	(38.62)	(44.81)	(44.80)	(44.07)			
BMI	34.40	33.95**	33.69$^{**!}$	35.02	35.14	35.08	.01$^{a\#\#}$	.00$^{a\#\#}$	.51
	(6.48)	(6.66)	(6.67)	(6.94)	(7.09)	(6.98)			
SE-Eat	44.05	46.51$^{**\wedge\wedge}$	59.85$^{**\wedge\wedge}$	43.34	39.19$^{\wedge\wedge}$	48.47$^{**\wedge\wedge}$	.00$^{\#\#}$	.00$^{\#\#}$	.01$^{\#\#}$
	(18.59)	(15.45)	(13.15)	(14.92)	(19.11)	(20.43)			
SE-PA	595.12	745.85**	822.68$^{**!}$	705.94	661.25	756.25$^{!}$	.00$^{b\#\#}$	.02$^{b\#}$	.81
	(266.53)	(262.82)	(265.87)	(251.04)	(350.06)	(308.44)			
SR-Eat	23.63	29.66$^{**\wedge\wedge}$	29.46**	25.66	26.97$^{**\wedge\wedge}$	28.00$^{**!}$	.00$^{\#\#}$	.00$^{\#\#}$	.58
	(6.87)	(5.39)	(6.82)	(5.79)	(5.82)	(7.03)			
SR-PA	31.59	36.32**	37.85**	35.78	36.06	37.59	.00$^{\#\#}$	.04$^{\#}$	.50
	(11.15)	(9.16)	(8.98)	(7.57)	(7.82)	(9.02)			
Fruit (c./d)	.96	1.36**	1.52**	1.21	1.46	1.65*	.00$^{\#\#}$	.79	.42
	(.85)	(1.01)	(.99)	(.97)	(1.11)	(1.14)			
Vegetable (c./d)	1.38	1.59	1.53	1.29	1.32	1.58$^{!}$	.17	.10	.59
	(1.09)	(1.03)	(1.03)	(.76)	(.79)	(1.00)			
Strength/ stretching (min/week)	18.29	38.05**	38.78**	30.00	29.06	52.97$^{*!}$	.00$^{\#\#}$	.09	.51
	(33.46)	(48.15)	(46.59)	(46.97)	(42.93)	(56.77)			
Aerobic (min/week)	117.07	169.02**	157.32	120.00	135.47	180.47*	.01$^{b\#\#}$	.19^{b}	.92
	(121.83)	(133.49)	(128.78)	(99.35)	(109.67)	(178.40)			

^{a}Greenhouse-Geisser correction reported; ^{b}Huynh-Feldt correction reported; $^{\#}p \leq .05$, multivariate test of the model; $^{\#\#}p \leq .01$, multivariate test of the model; $^{*}p \leq .05$, follow-up paired t-test compared to week-1; $^{**}p \leq .01$, follow-up paired t-test compared to week-1; $^{!}p \leq .05$, follow-up paired t-test compared to week-10; $^{\wedge\wedge}$ $p \leq .01$, independent t-test significant difference between groups

Weight. See Figure 4.2 for weight outcomes. The time main effect for the overall mixed ANOVA model was significant for weight, Wilks's Lamda = .891, $F(2, 70) = 4.284$, $p = .02$, $\eta_p^2 = .11$. Mauchley's W was significant (W = .508, $p = .00$) indicating equality of variance could not be assumed. A significant difference was found within-subjects for time effect, $F(1.34, 95.16) = 5.54$, $p = .01$, $\eta_p^2 = .07$ using the Greenhouse-Geisser correction for unequal variances.

The overall model was significant for time by group effect for weight, Wilks's Lamda = .885, $F(2, 70) = 4.569$, $p = .01$, $\eta_p^2 = .12$, however equal variance could not be assumed as Mauchley's W was significant. A significant difference was found for time by group effect when using the Greenhouse-Geisser correction for unequal variances, $F(1.34, 95.16) = 7.861$, $p = .003$, $\eta_p^2 = .10$. Profile plots show weight decreasing at week-10 and week-14 from baseline for the intervention group compared to an increasing trend in weight at week-10 and small decrease at week-14 for the control group. Weight did not change in the same way for both groups. This suggests an effect of the intervention on weight. However, there was no significant difference found for the between-subjects factor groups, $F(1, 71) = .603$, $p = .44$, suggesting that mean weights were not significantly different between groups at weeks 1, 10, or 14.

A follow-up test using one-way ANOVA did find a significant difference for mean weight change at week-10 between-subjects, $F(1, 71) = 8.12$, $p = .01$ and week-14 between subjects, $F(1,71) = 9.04$, $p = .00$. At week-10, the intervention group had a mean weight loss of 2.47 lbs (1.22 kg) (*SD* = 4.71 lbs (2.16 kg)) compared to the control group with a mean weight increase of .71 lbs (.32 kg) (*SD* = 4.76 lbs (2.19 kg)). The mean weight loss at week-14 for the intervention group was 4.10 lbs (1.86 kg) (*SD* = 6.09 lbs (2.77 kg)) and mean weight increase among the control group was .29 lbs (.13 kg) (*SD* = 6.34 lbs (2.88 kg).

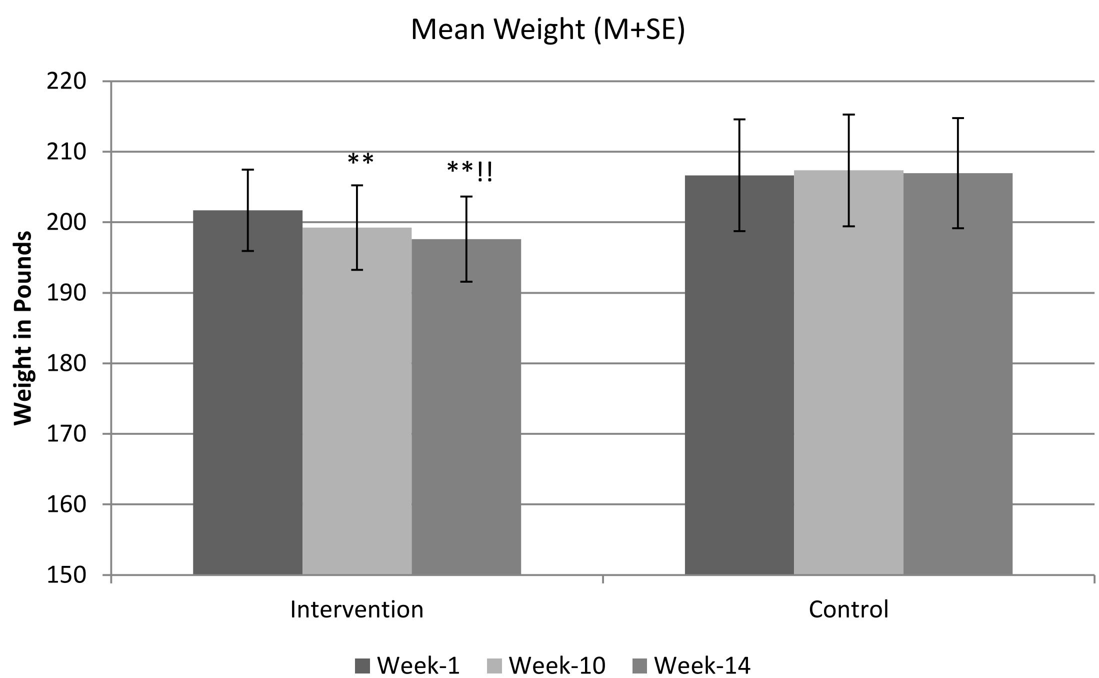

Figure 4.2: Comparison of Groups Mean Weights with Standard Errors
**$p \leq .01$, follow-up paired t-test compared to week-1; !!$p \leq .01$, follow-up paired t-test compared to week-10

A follow-up one-way repeated measures ANOVA for the intervention group only was significant for the model, Wilks's Lambda = .67, ($F(2, 39) = 9.49$, $p = .00$, $\eta_p^2 = .33$). However, Mauchley's W (W = .48, $p = .00$) was significant, indicating a violation of the assumption of homogeneity. The Greenhouse-Geisser correction for unequal variances was significant, $F(1.32, 52.66) = 15.42$, $p = .00$. Pairwise comparisons showed significant mean differences between week-1 to week-10, week-1 to week-14, and week-

10 to week-14 among the intervention group using repeated measures ANOVA. No significant difference was found for weight when analyzing the control group only using one-way repeated measures. Paired t-tests confirmed these results. Taken together, these results indicate an overall trend toward significant weight loss among the intervention participants at week-10 and week-14 and no significant weight change across time for the control group.

Body mass index. See Figure 4.3 for BMI outcomes. The time main effect for the overall model was significant for BMI, Wilks' Lamda = .90, $F(2,70) = 3.98$, $p = .02$, $\eta_p^2 = .10$, when using repeated measures mixed ANOVA. Mauchley's W was significant (W = .390, $p = .00$) indicating equality of variance could not be assumed. A significant difference was found within-subjects overtime for BMI using the Greenhouse-Geisser correction for unequal variances, $F(1.39, 98.74) = 5.36$, $p = .01$.

The overall time by group main effect for the model was significant for BMI, Wilks's Lambda = .880, $F(2, 70) = 4.77$, $p = .01$, $\eta_p^2 = .12$. However, Mauchley's W was significant (W = .390, $p = .00$) indicating equality of variance could not be assumed. A significant difference was found for time by group effect using the Greenhouse-Geisser correction for unequal variances, $F(1.39, 98.74) = 8.02$, $p = .00$. There was no significant difference found for the between-subjects time by group, $F(1, 71) = .447$ $p = .51$. Mean BMI did not significantly differ between groups at weeks 1, 10, or 14.

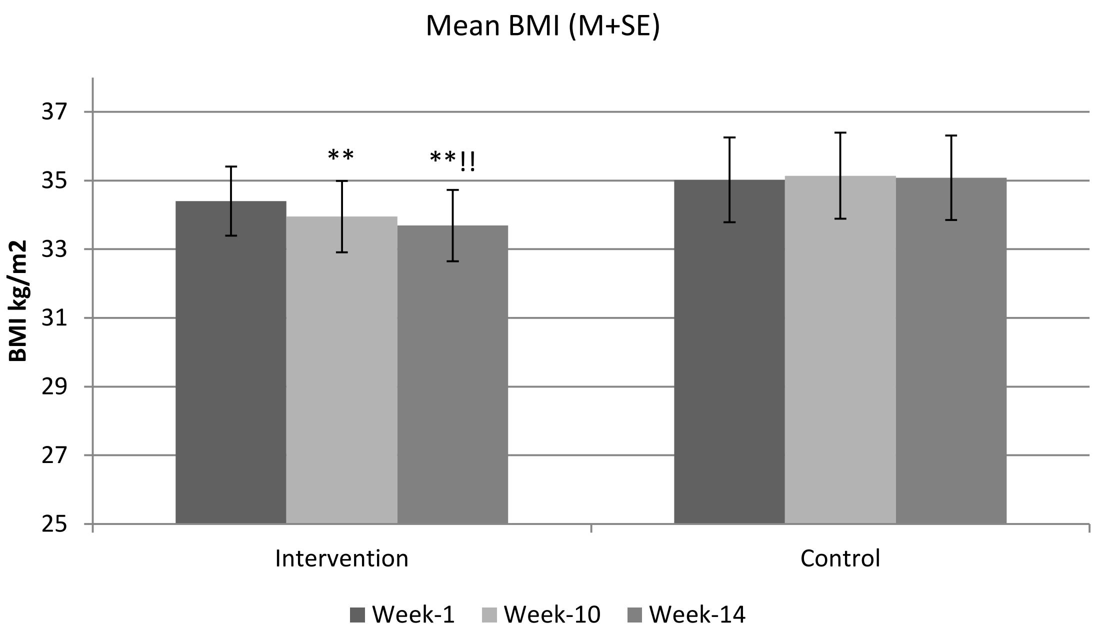

Figure 4.3: Comparison of Groups Mean BMIs with Standard Errors
$^{**}p \leq .01$, follow-up paired t-test compared to week-1; $^{!!}p \leq .01$, follow-up paired t-test compared to week-10

Similar to weight, a decreasing trend was evident in BMI for the intervention group compared to no significant change in the control group for BMI by profile plots. On follow-up tests, a significant difference was found between-subjects for change in BMI at week-10 using one-way ANOVA, $F(1, 71) = 8.47$, $p = .005$, $\eta_p^2 = .11$, and at week-14, $F(1, 71) = 9.36$, $p = .003$, $\eta_p^2 = .12$. The mean change in BMI at week-10 for the intervention group was a mean decrease of .45 kg/m^2 ($SD = .85$) compared to an increase in the control group of .13 kg/m^2 ($SD = .82$). At week-14, the intervention group had a mean decrease of .70 kg/m^2 ($SD = 1.04$) compared to control with a mean increase of .06 kg/m^2 ($SD = .1.06$). When repeated measures ANOVA was run separately for each group, the overall test for the model was significant, $F(2,39) = 9.27$, $p = .001$, $\eta_p^2 = .32$, for the intervention group but not the control group. Pairwise comparisons of mean differences were also significant at all measurement time points for the intervention group. Additionally, paired *t*-test were significant for a decrease in BMI at week-10, $t(40) = 3.38$, $p = .002$, and week-14, $t(40) = 4.32$, $p = .00$ among intervention participants.

Self-efficacy for eating. SE-Eat was measured using total WEL-SF scores. A higher score indicates higher SE. The overall multivariate test was significant for SE, Wilks's Lambda = .73, $F(2, 70) = 13.17$, $p = .00$, $\eta_p^2 = .27$. The test of within subjects was significant for time effect, $F(2, 142) = 15.63$, $p = .00$, $\eta_p^2 = .18$. SE for eating scores changed overtime and were significantly different at week-10, $F(1, 71) = 4.88$, $p = .03$, $\eta_p^2 = .06$ and week-14, $F(1, 71) = 14.26$, $p = .00$, $\eta_p^2 = .17$.

A significant main time by group effect for SE for eating was found, Wilks's Lambda = .78, $F(2, 70) = 9.82$, $p = .00$, $\eta_p^2 =.22$. The test of within subjects was significant for time by group effect, $F(2, 142) = 9.87$, $p = .00$, $\eta_p^2 = .12$, indicating SE did not change the same across groups over time. The tests of within subjects contrasts for time by group showed a significant difference at week-10 on how the groups rated SE, $F(1, 71) = 19.77$, $p = .00$, $\eta_p^2 = .22$. SE increased in the intervention group at week-10 and week-14 compared to the control group that decreased at week-10 and then increased above baseline at week-14.

The test of between-subjects for the group variable of SE for eating was also significant, $F(1, 71) = 8.45$, $p = .005$. Groups scored significantly differently on the WEL-SF scores. The mean SE for eating score for the intervention group increased from 44.05 (SD 18.59) to 56.41 (SD 15.45) from week-1 to week-10 compared to the control group which had a decrease in WEL-SF scores from 43.00 (SD 14.82) to 39.00 (SD 18.84). See Figure 4.4 for comparison of groups for SE for eating.

Paired samples t-tests were conducted to follow up the significant interactions by time effect. Differences in mean WEL-SF scores for the intervention group were significant from week-1 to week-10, $t(40) = -4.71$, $p = .00$, and from week-1 to week-14, $t(40) = -5.35$, $p = .00$, but not for week-10 to week-14. Differences in mean WEL-SF scores for the control group were significant from week-10 to week-14 only, $t(31) = -3.23$, $p = .003$.

An independent samples t-test was conducted to compare the means on dependent variables between the intervention and control group at week-1, week-10, and week-14. There was no significant difference between groups at week-1. The independent t-test was significant for WEL-SF scores, $t(71) = -4.26$, $p = .00$ at week-10. The intervention group had higher mean scores on self-efficacy for eating compared to the control group at week-10, $M = 56.41$, $SD = 15.45$ versus $M = 39.19$, $SD = 19.11$, respectively. The independent t-test was also significant for self-efficacy for eating at week-14, $t\ (50.21) = -2.74$, $p = .008$, but equal variances could not be assumed. Participants in the intervention group ($M = 59.85$, $SD = 13.15$) had higher mean scores on self-efficacy for eating behavior than the control group ($M = 48.47$, $SD = 20.43$) at week-14.

Figure 4.4: Comparison of Groups Mean SE for Eating with Standard Errors $^{**}p \leq .01$, follow-up paired t-test compared to week-1; $^{\wedge\wedge}p \leq .01$, independent t-test significant difference between groups

Self-regulation for eating. SR-Eat was measured and a total score calculated. A higher score indicates greater SR. See Figure 4.5 for comparison of groups for SR for eating. The mixed ANOVA main effect was significant, Wilks's Lambda = .62, $F(2, 70) = 21.12$, $p = .00$, $\eta_p^2 = .38$. There was a significant main time effect for SR for eating, $F(2, 142) = 22.71$, $p = .00$, $\eta_p^2 = .24$. SR-Eat scores changed overtime and were significantly different at week-10, $F(1, 71) = 35.74$, $p = .00$, $\eta_p^2 = .34$.

The model was also significant for time by group effect, Wilks's Lambda = .83, $F(2, 70) = 7.30$, $p = .001$, $\eta_p^2 = .17$. There was a significant main time by group effect for SR-Eat, $F(2, 142) = 6.71$, $p = .002$, $\eta_p^2 = .09$. The tests of within-subjects contrasts for time by group showed a significant difference at week-10, $F(1, 71) = 14.74$, $p = .00$, $\eta_p^2 = .17$. The test of between-subjects effects was not significant for SR-Eat.

Figure 4.5: Comparison of Groups Mean SR for Eating with Standard Errors
$^{**}p \leq .01$, follow-up paired t-test compared to week-1; $^{\wedge\wedge}p \leq .01$, independent t-test significant difference between groups; $^{!}p \leq .05$, follow-up paired t-test compared to week-10

Paired samples *t*-tests were conducted to follow up the significant interactions by time effect. The intervention group had a significant increase in SR-eat from week-1 to week-10 ($M = 23.63$, $SD = 6.87$ vs. $M = 29.66$, $SD = 5.39$), $t(40) = -6.74$, $p = .00$; and at week-14 ($M = 29.46$, $SD = 6.82$), $t(40) = -6.34$, $p = .00$. There was no significant difference in SR-eat for the control group at any time point.

An independent *t*-test showed a significant difference of means between groups at week-10 only for SR-eat, $t(71) = -2.04$, $p = .045$. The intervention group had a mean SR-eat at week-10 of 29.66 (*SD* = 5.39) compared to the control group with a mean SR-eat of 26.97 (*SD* = 5.82). The control group rated their level of SR-eat higher at baseline.

Self-efficacy for physical activity. SE-PA was measured using the PAAI and a total score calculated. A higher score indicates greater SE-PA. The overall multivariate test for the mixed ANOVA model was significant for the main time effect, Wilks's Lambda = .79, $F(2, 70) = 9.36$, $p = .00$, $\eta_p^2 = .21$ and for the time by group effect, Wilks's Lambda = .89, $F(2, 70) = 4.47$, $p = .02$, $\eta_p^2 = .11$. The test of between-subjects effects was not significant. See Figure 4.6 for comparison of groups for SE for physical activity.

The tests of within-subjects was significant for the main time effect using the Huynh-Feldt correction, $F(1.89, 134.02) = 9.81$, $p = .00$, $\eta_p^2 = .12$, indicating there was a change in SE-PA overtime for the groups. Tests of within-subjects contrasts were significant for week-10 to week-14, $F(1, 71) = 10.73$, $p = .002$, $\eta_p^2 = .13$.

There was a significant time by group main effect using the Huynh-Feldt correction, $F(1.89, 134.02) = 5.82$, $p = .004$, $\eta_p^2 = .08$, indicating the groups were changing overtime in different ways. The tests within-subjects contrasts was significant for week-1 to week-10, $F(1, 71) = 8.58$, $p = .005$, $\eta_p^2 = .12$. The mean SE-PA score increased for the intervention group at each time point in comparison to the control group, which decreased from baseline at week-10 and then increased at week-14.

Paired samples t-tests were conducted to follow up the significant interactions by time effect. There was a significant increase in SE-PA score for the intervention group from week-1 to week-10, $t(40) = -3.45$. $p = .001$, week-1 to week-14, $t(40) = -4.73$, $p = .00$, and week-10 to week-14, $t(40) = -2.22$. $p = .02$. The mean SE-PA for the control group had a non-significant decrease at week-10 ($M = 661.25$, $SD = 350.06$) from baseline ($M = 705.94$, $SD = 251.04$), followed by a significant increase at week-14 ($M = 756.25$, $SD = 308.44$), $t(31) = -2.40$. $p = .02$.

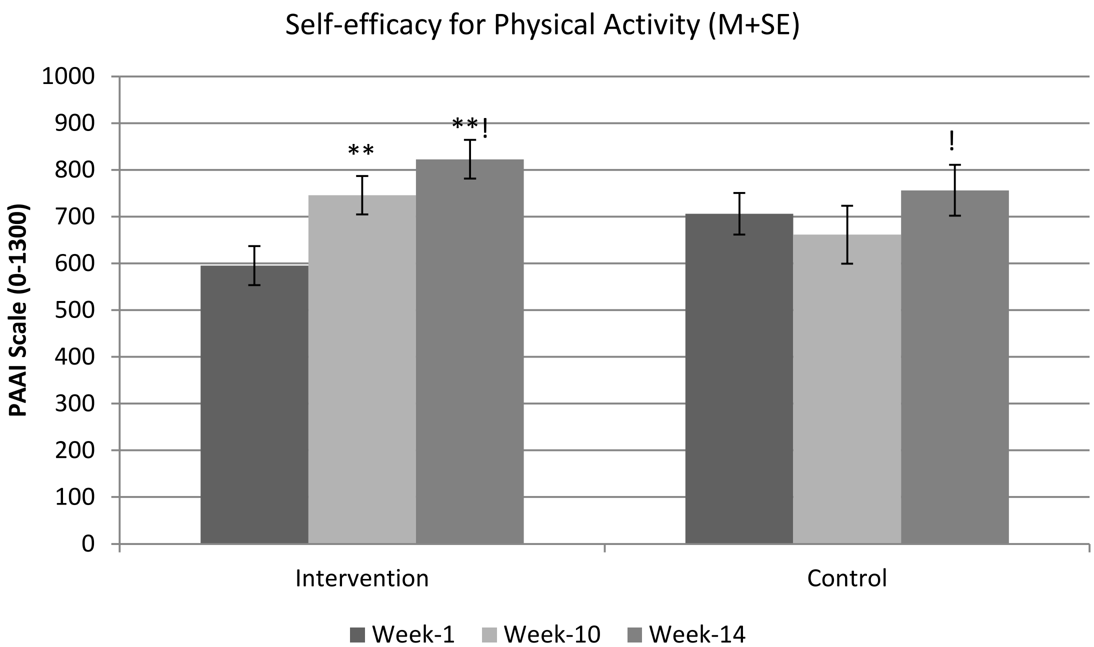

Figure 4.6: Comparison of Groups Mean SE for Physical Activity with Standard Errors
$^{**}p \leq .01$, follow-up paired t-test compared to week-1; $^{!}p \leq .05$, follow-up paired t-test compared to week-10

Self-regulation for physical activity. SR-PA was measured and a total score calculated. A higher score indicates greater SR-PA. The overall multivariate test for the mixed ANOVA model was significant for the main time effect, Wilks's Lambda = .83,

$F(2, 70) = 7.23$, $p = .001$, $\eta_p^2 = .17$, and for the time by group effect, Wilks's Lambda = .92, $F(2, 70) = 3.07$, $p = .05$, $\eta_p^2 = .08$. The test of between-subjects effects was not significant. See Figure 4.7 for comparison of groups for SR for physical activity.

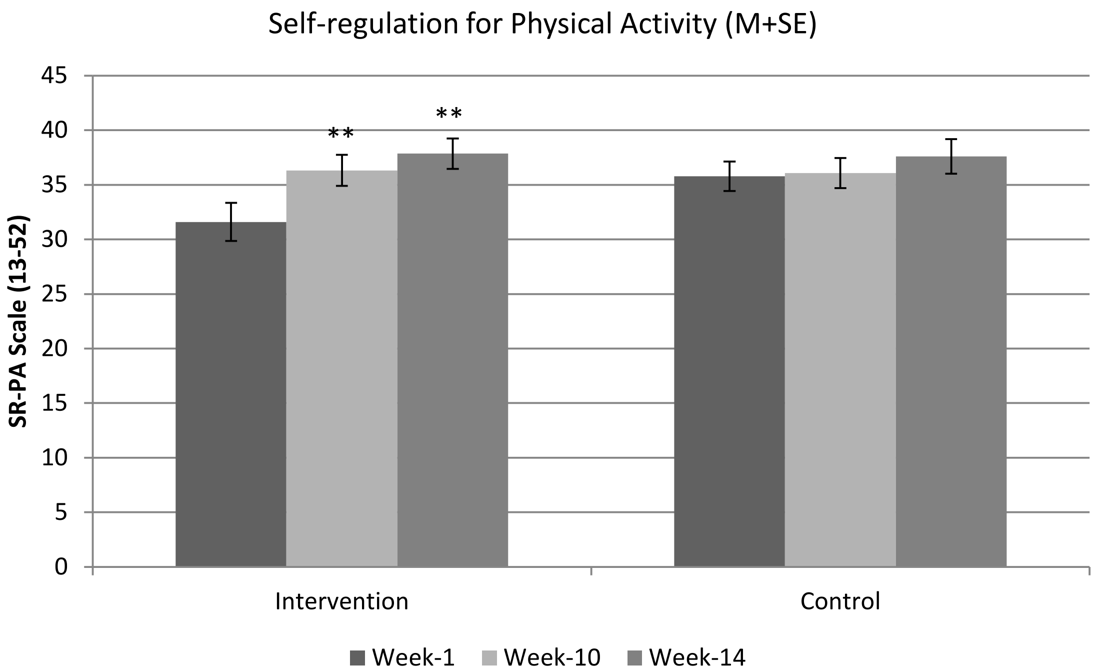

Figure 4.7: Comparison of Groups Mean SR for Physical Activity with Standard Errors
$^{**}p \leq .01$, follow-up paired t-test compared to week-1

The tests of within-subjects effect were significant for both the main time effect, $F(2, 142) = 8.53$, $p = .00$, $\eta_p^2 = .12$, and time by group effect, $F(2, 142) = 3.39$, $p = .04$, $\eta_p^2 = .05$. There was a significant test of within-subjects contrast for time effect at week-1 to week-10 for both the time effect, $F(1, 71) = 6.83$, $p = .01$, $\eta_p^2 = .09$, and time by group effect, $F(1, 71) = 5.38$, $p = .02$, $\eta_p^2 = .07$. There was no significant difference from week-10 to week-14. The control group had a higher mean SR-PA score ($M = 35.78$, *SD*

= 7.57) at week-1 compared to the intervention group (*M* = 31.59, *SD* = 11.15), but this was not significantly different.

Paired *t*-tests were conducted to evaluate time effects further. At week-10, the intervention group had a significant increase, 4.73, from baseline for the mean of SR-PA (*M* = 31.59 to *M* = 36.32), *t*(40) = -3.63, *p* = .001, compared to the control group, .28 (*M* = 35.78 to *M* = 36.06). There was also a significant increase from baseline to week-14, *t*(40) = -4.29, *p* = .00 among the intervention group but not from week-10 to week-14. The control group had no significant change in SR-PA at any time point. The groups remained similar from week-10 to week=14.

Fruit intake. Fruit intake was measured by estimated cups consumed daily. The overall multivariate test for the mixed ANOVA model was significant for the main time effect, Wilks's Lambda = .81, *F*(2, 70) = 8.09, *p* = .001, η_p^2 = .19, but not for the time by group effect. The test of between-subjects effects was not significant.

The tests of within-subjects effect was significant for the main time effect, *F*(2, 142) = 9.19, *p* = .00, η_p^2 = .12, indicating the groups had a change fruit intake overtime. The tests of within-subjects contrasts showed a significant change occurred from week-1 to week-10, *F*(1, 71) = 6.70, *p* = .01, η_p^2 = .09. The profile plot shows a similar increase in fruit intake between both groups.

Paired *t*-tests were conducted to follow up the significant interactions by time effect. There was a significant increase in fruit intake among the control group from week-1 (*M* = 1.21, *SD* = .97) to week=14 (*M* = 1.65, *SD* = 1.14), *t*(31) = -2.26, *p* = .03.

The intervention group had a significant increase in fruit intake from baseline (M = .96, SD = .85) to week-10 (M = 1.36, SD = .1.01), $t(40) = -2.59$, $p = .01$, and to week-14, (M = 1.52, SD = .99), $t(40) = -3.58$, $p = .001$. The intervention group had a lower fruit intake at baseline. Fruit intake between groups was not significantly different at any time points. See Figure 4.8 below comparing fruit intake among groups by week.

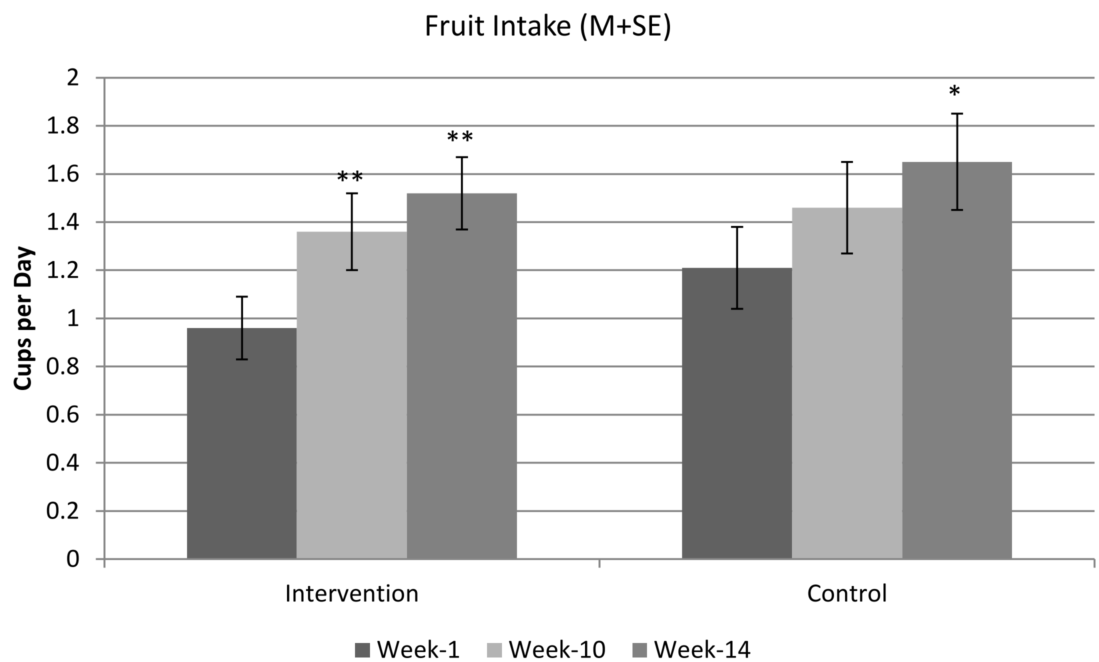

Figure 4.8: Comparison of Groups Mean Fruit Intake with Standard Errors
$^{**}p \leq .01$, follow-up paired t-test compared to week-1, $^{*}p \leq .05$, follow-up paired t-test compared to week-1

Vegetable intake. Vegetable intake was measured by estimated cups consumed daily. The overall multivariate test for the mixed ANOVA model was not significant for the main time effect or the time by group effect. The test of between-subjects effects was not significant. This indicates there was no change in vegetable intake over time and no difference in vegetable intake between the control and intervention group.

Strength and stretching. Strength and stretching exercise was measured by estimated minutes per week. The overall multivariate test for the mixed ANOVA model was significant for the main time effect, Wilks's Lambda = .85, $F(2, 70) = 5.98$, $p = .004$, $\eta_p^2 = .15$, but not for the time by group effect. The test of between-subjects effects was not significant. See Figure 4.9 comparing strength and stretching exercise minutes per week among groups.

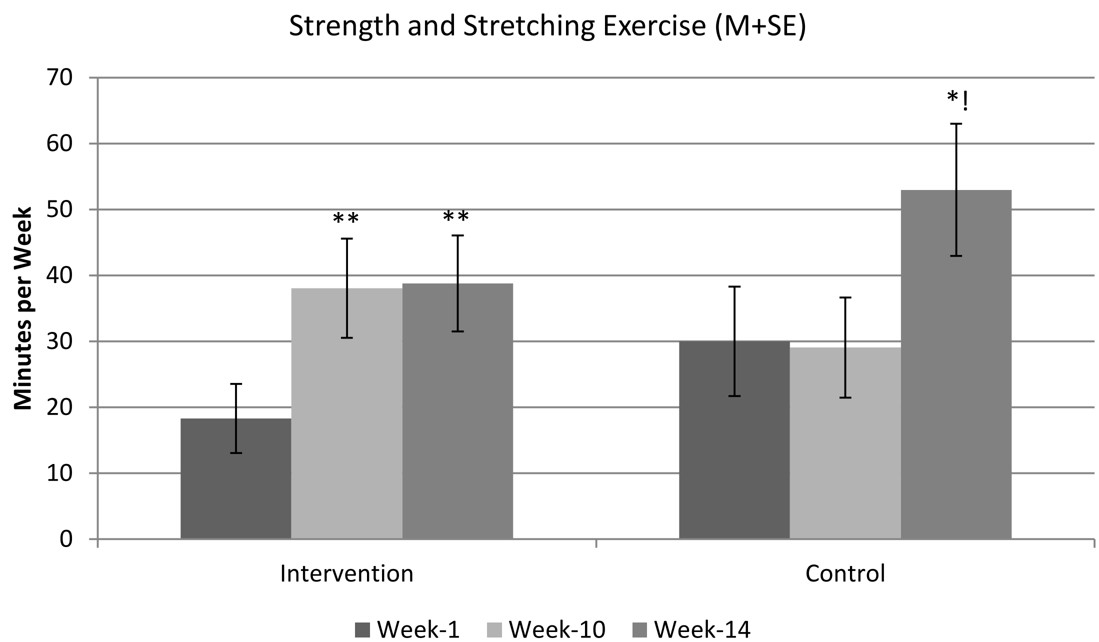

Figure 4.9: Comparison of Groups Mean Minutes of Strength and Stretching Exercise with Standard Errors $^{**}p \leq .01$, follow-up paired t-test compared to week-1, $^{*}p \leq .05$, follow-up paired t-test compared to week-1, $^{!}p \leq .05$, follow-up paired t-test compared to week-10

The tests of within-subjects effect was significant for the main time effect, $F(2, 142) = 6.77$, $p = .002$, $\eta_p^2 = .09$, indicating the groups had a change in minutes of strength and stretching exercise overtime. The tests of within-subjects contrast was significant for week-10 to week-14, $F(1, 71) = 4.09$, $p = .05$, $\eta_p^2 = .05$.

Paired t-tests were conducted to follow up the significant interactions by time effect. There was a significant increase in minutes of strength and stretching exercise among the control group from week-1 ($M = 30.00$, $SD = 46.97$) to week-14 ($M = 52.97$, $SD = 56.77$), $t(31) = -2.21$, $p = .04$, and week-10 ($M = 29.06$, $SD = 42.93$) to week-14, $t(31) = -2.43$, $p = .02$. Among the intervention group, there was a significant increase in minutes of strength and stretching exercise from week-1 ($M = 18.29$, $SD = 33.46$) to week-10 ($M = 38.05$, $SD = 48.15$), $t(40) = -2.62$, $p = .01$, and week-1 to week-14 ($M = 38.78$, $SD = 46.59$), $t(40) = -2.74$, $p = .009$, but not for week-10 to week-14.

Aerobic exercise. Aerobic exercise was measured by estimated minutes per week. The overall multivariate test for the mixed ANOVA model was significant for the main time effect, Wilks's Lambda = .89, $F(2, 70) = 4.40$, $p = .02$, $\eta_p^2 = .11$, but not for the time by group effect. The test of between-subjects effects was not significant.

The tests of within-subjects effect was significant for the main time effect using the Huynh-Feldt correction, $F(1.76, 125.01) = 5.37$, $p = .008$, $\eta_p^2 = .07$, indicating the groups had a change in minutes of aerobic exercise overtime. The tests of within-subjects contrast was significant for week-1 to week-10, $F(1, 71) = 6.80$, $p = .01$, $\eta_p^2 = .09$.

Paired t-tests were conducted to follow up the significant interactions by time effect. There was a significant increase in minutes of aerobic exercise (M increase =

60.47) among the control group from week-1 (M = 120.00, SD = 99.35) to week-14 (M = 180.47, SD = 178.40), $t(31) = -2.06$, $p = .05$. Among the intervention group, there was a significant increase in minutes of aerobic exercise from week-1 (M = 117.07, SD = 121.83) to week-10 (M = 169.02, SD = 133.49), $t(40) = -2.78$, $p = .008$. A small non-significant decrease in minutes of exercise was seen between week-10 to week-14 indicating a leveling off in aerobic exercise after the intervention was complete. Figure 4.10 shows the comparison of groups for minutes of aerobic exercise per week at measurement time points.

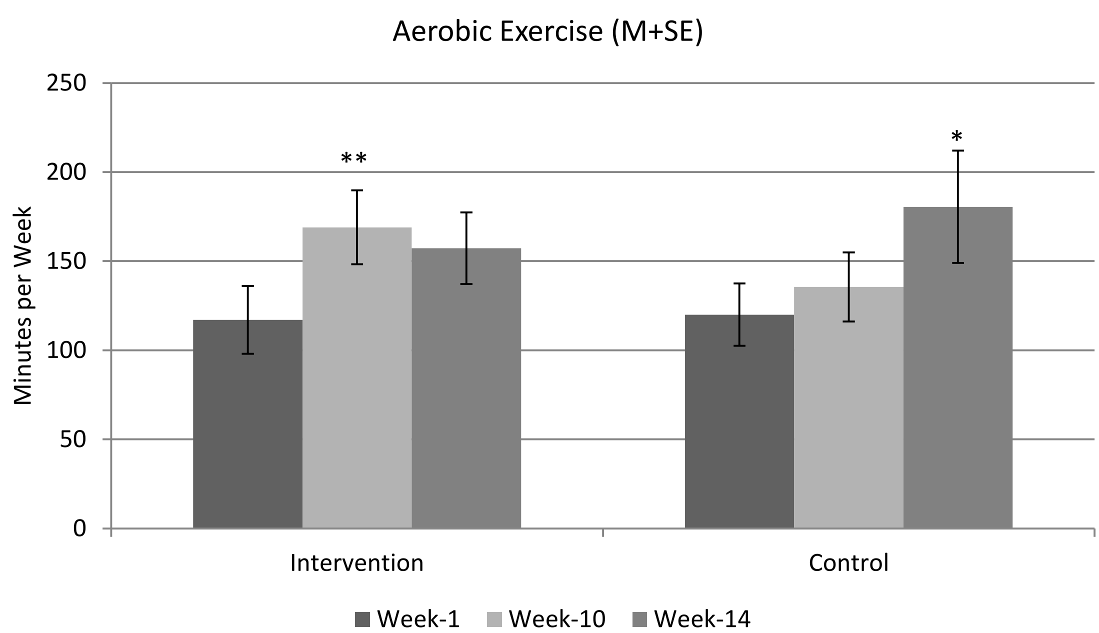

Figure 4.10: Comparison of Groups Mean Minutes of Aerobic Exercise with Standard Errors $^{**}p \leq .01$, follow-up paired t-test compared to week-1, $^{*}p \leq .05$, follow-up paired t-test compared to week-1

Pearson's Correlations

Pearson's correlations were run to determine magnitude and significance of relationships between SE and SR for eating and exercise and weight, weight change, fruit and vegetable intake, and exercise frequency for the intervention group only. Significant Pearson correlation coefficients for SE and SR for eating behaviors among the intervention group are examined here.

As shown in Table 4.5, positive significant correlations were found between total SE-Eat and total SR-Eat at each measurement time point. Change in SE-Eat and SR-Eat scores were significantly positively correlated at week-14 but not at week-10. Overall, correlations were weak to moderate with weak effect sizes.

SE-Eat was significantly positively correlated with vegetable intake at week-1 and fruit intake and change in fruit intake at week-14. SE-Eat was not shown to correlate with weight or weight change at any measurement time point except week-14. However, the change in SE-Eat at week-10 was significantly negatively correlated with weight change at week-10, meaning a greater decrease in amount of weight loss was correlated with an increase in SE-Eat. Change in SE-Eat also significantly positively correlated with change in vegetable intake at week-10, meaning as vegetable intake increased, SE-Eat also increased. In addition, change in SE-Eat was significantly positively correlated with change in vegetable intake at week-14 as well.

Baseline and week-10 SR-Eat scores were weak but significantly negatively correlated with weight at baseline, week-10, and week-14 suggesting a higher SR-Eat score was associated with a lower body weight. Change in SR-Eat scores at week-10 and 14 were significantly negatively correlated with weight change at week-14. Greater weight loss was associated with greater change in SR.

Table 4.5

Intervention Group Significant Pearson Correlation Coefficients for SE and SR for Eating Compared to Weight, Weight Change and Fruit and Vegetable Intake (n = 41)

Variable A	**Variable B**	***r***	***p***	R^2
Wk-1 SE-Eat	Wk-1 SR-Eat	.32	.04	.10
	Wk-1 Veg intake	.36	02	.13
Wk-1 SR-Eat	Wk-1 Weight	-.33	.03	.11
	Wk-1 Veg intake	.46	.00	.21
	Wk-14 Chang veg intake	.32	.05	.10
	Wk-14 Weight	-.32	.04	.10
Wk-10 SE-Eat	Wk-10 SR-Eat	.40	.01	.16
Wk-10 Change SE-Eat	Wk-10 Weight change	-.35	.02	.12
	Wk-10 Change veg intake	.35	.02	.12
Wk-10 SR-Eat	Wk-10 Weight	-.35	.03	.12
	Wk-10 Fruit intake	.48	.00	.23
	Wk-10 Change fruit intake	-.40	.01	.16
	Wk-14 Weight	-.37	.02	.14
Wk-10 Change SR-Eat	Wk-10 Weight change	-.43	.01	.18
	Wk-10 Change veg intake	.43	.01	.18
	Wk-14 Weight change	-.33	.03	.11
Wk-14 SE-Eat	Wk-14 SR-Eat	.37	.02	.14
	Wk-14 Weight change	.37	.02	.14
	Wk-14 Change fruit intake	-.35	.03	.12
Wk-14 Change SE-Eat	Wk-14 Change SR-Eat	.45	.00	.20
	Wk-14 Change veg Intake	.32	.04	.10
Wk-14 SR-Eat	Week-14 Fruit intake	.42	.01	.18
	Wk-14 Change fruit intake	.34	.03	.12
Wk-14 Change SR-Eat	Wk-14 Change fruit Intake	.41	.01	.17
	Wk-14 Change veg intake	.32	.04	.10
	Wk-14 Weight change	-.48	.00	.23

$p \leq .05$ = significant results

At baseline, SR-Eat was moderately positively correlated with vegetable intake but not fruit intake, whereas SR-Eat at week-10 and week-14 was positively correlated with fruit intake but not vegetable intake. There was a weak but positive significant correlation between week-1 SR-Eat and change in vegetable intake from week-1 to week-14 as well as change in SR-Eat and change in vegetable intake at week-10. This means that a greater increase in vegetable intake at week-14 was associated with a lower SR-Eat score at week-1 and a greater increase in change of SR-Eat was associated with greater increase in vegetable intake at the end of the intervention, week-10. Additionally, higher SR-Eat scores at week-10 and week-14 were associated with a greater increase in fruit intake at both time points. In summary, as SR-Eat score increased, fruit and vegetable intake increased.

Examined here and reported in Table 4.6, significant Pearson correlation coefficients for SE and SR for exercise behaviors related to weight, weight change, and minutes of strength/stretching and aerobic exercise among the intervention group. There were weak but significant positive correlations between total SE-PA and total SR-PA at all measurement time points, indicating SE-PA relates to SR-PA. Week-1, week-10, and week-14 SE-PA was not significantly correlated with weight, weight change, or exercise frequency at any measurement time point and therefore are excluded from the table.

Weak to strong positive significant correlations were found at week-1, week-10, and week-14 between SR-PA and minutes per week of strength and stretching exercise and minutes per week of aerobic exercise. SR-PA was most strongly correlated with minutes of aerobic exercise at week-1, $r = .70$, $p = .00$, $R^2 = .49$, and at week-10, $r = .71$, $p = .00$, $R^2 = .50$.

There was a weak but positive significant correlation between change in SE-PA at week-10 and change in total aerobic exercise in minutes per week at week-10, indicating a greater increase in SE-PA was associated with a greater increase in total minutes of aerobic exercise at week-10. Additionally, there was a moderate positive significant correlation between change in SR-PA at week-10 and week-14 with change in total minutes of aerobic exercise per week at both time points. SR-PA appears to have a greater influences on time spent in aerobic exercise as well as strength and stretching exercise than SE-PA.

Table 4.6
Intervention Group Significant Pearson Correlation Coefficients for SE and SR for Exercise to Weight, Weight Change and Exercise Frequency (n = 41)

Variable A	**Variable B**	***r***	***p***	R^2
Wk-1 SE-PA	Wk-1 SR-PA	.43	.01	.18
Wk-10 SE-PA	Wk-10 SR-PA	.36	.02	.13
Wk-14 SE-PA	Wk-14 SR-PA	.37	.02	.14
	Wk-14 Weight change	-.35	.02	.12
Wk-10 Change SE-PA	Wk-10 Change aerobic exercise	.32	.04	.10
Wk-1 SR-PA	Wk-1 minutes strength/ stretching exercise	.38	.02	.14
	Wk-1 minutes aerobic exercise	.70	.00	.49
Wk-10 SR-PA	Wk-10 minutes strength/ stretching exercise	.44	.00	.19
	Wk-10 minutes aerobic exercise	.71	.00	.50
Wk-10 Change SR-PA	Wk-10 Change minutes aerobic exercise	.45	.00	.20
Wk-14 SR-PA	Wk-14 minutes strength/ stretching exercise	.43	.00	.18
	Wk-14 minutes aerobic exercise	.54	.00	.29
Wk-14 Change SR-PA	Wk-14 Change minutes aerobic exercise	.50	.00	.25

Significance set at $p \leq .05$

Qualitative Results

Table 4.7 includes baseline characteristics of the 11 participants who participated in individual semi-structured interviews regarding social influence on SE and SR for eating and exercise behaviors. Figure 4.2 includes direct quotes organized by major themes that emerged among the participant interview responses regarding social influence on SE and SR for eating and exercise behaviors for weight loss.

Table 4.7
Baseline Characteristics of Individual's Who Participated in Interviews About Social Influence on SE and SR for Eating and Exercise (n = 11)

Characteristic	*M*	*(SD)*
Age	50.64	(9.42)
Weight (lbs)	194.78	(31.82)
Body Mass Index	33.45	(5.30)
No. of friends overweight	5.73	(4.74)
No. of friends trying to lose weight	3.73	(4.27)
SE-Eat	43.36	(16.52)
SE-PA	684.55	(189.49)
SR-Eat	26.00	(6.74)
SR-PA	35.45	(12.52)
Fruit intake (cups/day)	1.23	(.82)
Vegetable intake (cups/day)	1.68	(1.30)
Strength/stretching exercise (min/week)	30.00	(47.91)
Aerobic exercise (min/week)	136.36	(119.33)

Responses to the demographic questionnaire indicated 6 of the 11 interview participants attended the intervention program with a co-worker. Two others indicated a co-worker encouraged them to participate. At the time of interviews during weeks 11 and 12, 6 responded that they did not intentionally participate in the program with a co-worker, and 3 stated that they knew others in the program. Two reported influence by co-workers who had previously participated in an earlier offering of the program, while four knew others who had previously participated but did not feel influenced by them. Two of these four did not know others who previously participated until after beginning the program. One participant stated that they knew someone in the program and communicated with them regularly for work purposes, but did not consider them a co-worker because they worked in a different department. Participants were more likely to report influence of a co-worker if they worked in the same department, clinic, or shared an office. Multiple participants commented that they do not have time to socialize at work. Lunch schedules are different, people have other things to do at lunch or on breaks, and once work is over, they go home. They do not socialize with co-workers outside of the workplace.

When asked, the majority of interview participants did not perceive a direct influence of co-workers on their decision to participate in the intervention, or on their SE and SR of eating and exercise behaviors related to weight management. Most described the influence of attending the class as a whole and being part of a group as opposed to a single co-workers influence. In one instance, the interviewee felt the negative comments sometimes made during the class sessions by participants was actually a deterrent to making healthy lifestyle changes.

Data Themes

Participant interview responses were transcribed and coded with QSR NVivo 10. Seven major themes were identified and organized by the constructs of SE and SR. Select participant responses for each theme are included in Figure 4.11.

SE: Support. Participants talked about the benefit of having others to talk to who were experiencing the same struggles with managing their weight and trying to adopt healthier eating and exercise habits. Within this context was help with problem solving and the sense of a safe environment to share concerns. Some also mentioned the support of family members. “My daughter was supportive and actually said healthy eating is not that bad.”

SE: Role modeling. Participants reported both looking toward others as role models as well as acting as role models themselves. “When you are the one losing weight and people turn to you it helps you want to do better and when you find yourself helping others that in turn helps with motivation.” Participants reported they were motivated to try new strategies by listening to what others said they were doing during the class sessions. “One of the ladies talked about going to water aerobics. I am interested in trying that because it works the whole body.”

Construct	Theme	Select Quotes
SE	Support	"They influenced me as far as I am not the only one, we are on the same journey and have the same barriers. The group was supportive." "You have someone to go to, to meet with on a one on one basis when you are feeling discouraged." "There was that support system without pressure."
	Role modeling	"One person said that they started walking instead of taking the shuttles so I started doing that." "I am watching how others are doing it. I watch my co-worker to see what she is doing." "I found it motivating to kind of be a role model. I would talk on the phone to my sister and tell her what we talked about every week."
SR	Accountability	"Having to weigh in and not wanting to be embarrassed motivates me to keep on keeping on." "Being with the group helped keep me accountable, knowing I was coming to weigh each week." "Weighing in every time was a big help. I had to answer to an outside force and that is very very helpful."
	Competition	"It was a little like a competition. Not that I wanted to lose more than she did, but when she lost then I wanted to lose more." "I think the little bit of the competitive spirit came out, the confidence was increased by seeing my results compared to others results." "I would see them taking the elevator while I am taking the stairs. That did boost my confidence because I compared favorably."
	Awareness & Planning	"Well I am very much more aware. I now look at all the labels on the foods and like trying to plan out more of what I eat." "So packaging my meals at the beginning of the weak has made such a difference. I started to eat more fruits and vegetables." "Have my work out scheduled and have my prepackaged snacks ready for when I am studying instead of going to the vending machines and having chips."
	Motivation	"I think when you have a co-worker who is positive about the program and you want to make the changes as well, then you find yourself more motivated and encouraged." "I have more motivation. The more I lose, the more I want to lose." "My goal is to continue to dress from the gap I don't want to shop at lane Bryant. I don't want to be in the fat clothes. I want to be able to dress cute."
	Lifestyle	"I stopped thinking of it like a diet was the biggest thing." "It is about changing your lifestyle and how you eat." "I keep in the back of my mind it is a lifestyle and mental talk to myself that I want to get to the goal of 140."

Figure 4.11: Major Themes and Direct Quotes of Participants from Semi-structured Interviews

SR: Accountability. Multiple participants mentioned that a sense of accountability was a motivator for making changes to eating and exercise habits. This mainly stemmed around the influence of weekly weigh-ins at each class session rather than the influence of a co-worker. Participants reported making a conscious effort to eat healthier and be more active knowing that they would be weighed-in each week. One participant mentioned the issue of not meeting others' expectations and needing to be accountable. "When you talk about it with co-workers you set up certain expectations you have to meet. They are aware that you are doing things to eat more healthfully so if there is a box of cookies in the break room they warn me not to eat the cookies."

SR: Competition. A sense of competition emerged in the participant responses. Several reported the influence of knowing others had lost weight and felt encouraged by this to increase their own efforts to lose more weight. Those that had lost the most weight reported an increase in confidence and motivation for eating and exercise behavior changes as they felt competitiveness with others, desire to "beat them", and knew they were doing better.

SR: Awareness and planning. Participants indicated that the class sessions and food journaling had an influence on increasing awareness of and planning for eating and physical activity, not individual co-workers. "Writing the things down on the log and seeing what I do eat has influenced me, before I didn't think about it much." This influenced participants' nutrition and physical activity habits. "My pantry is now filled with two huge jars of peanut butter, there is always a carton of hard boiled eggs in my refrigerator, a quick and healthy breakfast, there is fruit in my refrigerator and vegetables, and there is oatmeal in my desk drawer instead of Little Debbie's cakes. I have peanuts for a quick snack."

SR: Motivation. Participants were more likely to comment on personal goals or achievement of desired results as motivating factors more so than a co-workers influence on motivation for behavior change. "Motivation really came from feeling better, seeing the results on the scale and my clothes being looser, more so than influence from anybody else." Some did refer to the intervention class itself as a motivating factor. "Being part of the class helped motivate me more." One participant commented on how helping others was a source of motivation for behavior change. "When you are the one losing weight and people turn to you it helps you want to do better and when you find yourself helping others that in turn helps with motivation."

SR: Lifestyle. Several participants commented on a change in mindset or way of thinking about eating and exercise habits as a new lifestyle compared to thinking of it as a short-term diet. "So my goal is to have a lifestyle of healthy eating rather than be on and off a diet." Some talked about how they incorporated new eating habits to fit a new lifestyle approach. "I am not starving myself. I eat a normal meal but not on a dinner plate. I am eating on a salad plate." "We now have strawberries, watermelon, cantaloupe, grapes, and there wasn't anyone on the boat that complained about it. Everyone was wondering when we were going to pull out the big bucket of fruit."

Conclusion

In summary, 41 intervention participants and 32 control participants completed all components of the study. Greater weight loss and greater increase in SR-Eat correlated with greater attendance of class sessions among the intervention group. Mixed ANOVA tests showed significance for the main time effect and time by group effect for weight, BMI, SE-Eat, SE-PA, SR-Eat, and SR-PA. Only the main time effect was significant for cups of fruit intake per day, minutes of strength and stretching exercise per week, and minutes of aerobic exercise per week. The mixed ANOVA between-subjects effect was only significant for SE-Eat. Follow-up paired *t*-tests were significant for weight loss, decrease of BMI, and increase in SE-Eat, SE-PA, SR-Eat, SR-PA, fruit intake, strength and stretching exercise, and aerobic exercise within the intervention group. Follow-up independent *t*-tests were significant at week-10 and week-14 for SE-Eat and at week-10 only for SR-Eat. In addition, intervention group participants reported feeling supported by the class or co-workers within the class and indicated influence of behaviors modeled by others and for others within their own social context. Lastly, class participants reported an increased sense of accountability, competitiveness, awareness and planning, motivation, and change in way of thinking about eating and exercise behaviors as a lifestyle as a result of participating in the intervention with co-workers.

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

This final chapter provides a brief summary of the research conducted followed by conclusions based on the findings of the statistical and qualitative analyses. Included is a discussion of findings in comparison to existing literature and implications for the field of health studies. Recommendations for practice and future research close the chapter.

Summary

The primary purpose of this experimental mixed methods study was to evaluate change in SE and SR for eating and physical activity behaviors and body weight among female employees participating in a 10-week worksite weight loss intervention. The secondary purpose was to assess perceptions of social influence on SE and SR for eating and physical activity behaviors among a subset of the intervention participants via semi-structured interviews. Participants included adult female employees of UT Southwestern Medical Center with a BMI of 25 kg/m^2 or higher. Participants completed online previously validated questionnaires designed to quantitatively assess degree of SE and SR for eating and physical activity behaviors related to weight management at baseline, week-10 (end of intervention), and week-14 (4-week follow-up post intervention). Eleven participants from the intervention group took part in audio-recorded semi-structured interviews at weeks 11 and 12.

Conclusion

Primary Outcomes

Overall, there were not significant differences between subjects by mixed ANOVA except for SE for eating behavior. However, the 10-week intervention had a positive and statistically significant time effect and time by group effect for SE and SR for eating and exercise behaviors, weight, and BMI among intervention participants compared to controls. The intervention group had statistically significant decreases in weight and BMI, and statistically significant increases for SE-Eat, SE-PA, SR-Eat, and SR-PA over time and for time by group effect and statistically significant increases for fruit intake and minutes of strength and stretching exercise over time at week-10 compared to the control group. Among the intervention group, SE and SR for eating and exercise behaviors significantly increased at week-10 and at week-14 follow-up, and there was a significant weight loss at week-10 and 14. Daily fruit intake and minutes of strength and stretching exercise per week significantly increased at week-10 and 14, while minutes of aerobic exercise significantly increased at week-10 and remained stable at the week-14 follow-up among the intervention group. These results support the conclusion that the intervention had an effect on participants.

The control group did have a statistically significant increase in SE-Eat at week-14 and a significant increase in SR-Eat at week-10 and 14. However, the increase in SE-Eat and SR-Eat was greater among the intervention group. Weight increased slightly among the control participants at week-10. The control group also had significant increases in fruit intake, strength and stretching, and aerobic exercise at week-14 follow-up but not at week-10, the end of the intervention. A testing effect among the control group may partially explain this phenomenon. Multiple control group participants commented at the final weigh-in that the survey questions caused them to think about their eating and exercise behaviors and some reported changing behaviors as a result.

Although the results show significant increases in SE and SR for eating and exercise, fruit intake, and exercise behavior for the intervention group supporting an intervention effect, only SE-Eat and SR-Eat significantly differed between groups at week-10 and for SE-Eat only at week-14 follow-up. The control group rated themselves higher at baseline on all variables except SE-Eat at week-1, but a statistical difference between groups was not apparent. The groups were also similar in terms of self-rating of SE and SR for eating and exercise behavior, fruit and vegetable intake, and frequency of exercise behavior at week-10 and 14. Therefore, using mixed ANOVA there was no statistical difference between groups except for SE-Eat and results are insufficient to reject all null hypotheses. Table 5.1 indicates rejection of only one of the null hypotheses.

Table 5.1
Test of Null Hypotheses Comparing Intervention and Control Participants at the 0.05% Level of Significance

When comparing participants and controls in the pre- and post-tests, there will be no statistically significant difference in:	Null Hypothesis
SE-Eat	Rejected
SE-PA	Not rejected
SR-Eat	Not rejected
SR-PA	Not rejected
Body weight (lbs)	Not rejected

Among the intervention participants who participated in semi-structured interviews, the perception of social influence on SE and SR for eating and exercise behaviors for managing weight was low. In general, interviewees did not perceive others to be directly influencing their confidence or control over health behaviors. However, themes emerged from responses to questions that suggest social influence did occur between co-workers attending the intervention. Themes related to SE included support and role modeling. Interviewees commented on the benefit of having a support system of others facing similar challenges with managing weight. They also mentioned observing what others were doing for ideas that they may adopt to help with their own weight loss efforts. A few also commented that they were acting as role models for others outside of the intervention class.

Themes that emerged related to SR included accountability, competition, awareness and planning, motivation, and lifestyle. Interviewees commented that attending the class and weekly weigh-ins influenced personal accountability for behaviors, making them more aware of their decisions. They did not want to be the one in the class not losing weight. A sense of competition to lose more weight than other participants also influenced decision making related to weight loss behaviors. When a participant lost weight or saw that others lost weight there was increased motivation to continue with behavior changes. Furthermore, interviewees reported paying more attention to the types of foods they were choosing and making more of an effort to plan for healthy eating and physical activity. Finally, several talked about making a change in the way they think about healthy behaviors, making changes part of everyday lifestyle instead of temporary changes. It is evident in the comments that there is an underlying social influence, although participants may not perceive that social influences have an impact on their confidence or control of thoughts and decision making for eating and exercise behaviors.

Secondary Outcomes

SR-Eat was weak to moderately significantly correlated with body weight among the intervention group participants. Greater ratings of SR-Eat correlated with lower body weight at week-1 and week-10, and an increase in SR-Eat also correlated with greater weight loss at week-10 and 14. Similarly, a greater increase in SE-Eat was associated with greater weight loss at week-10. However, SE-Eat was not associated with body weight at any other time point suggesting that focusing on SR-Eat may be more important for weight loss.

SE-Eat and SR-Eat appear to play a role in eating behaviors. SE-Eat and SR-Eat had weak to moderate significant correlations to eating behaviors among the intervention group participants. Change in SR-Eat and SE-Eat positively correlated with change in vegetable intake at week-10 and week-14 follow-up although change in vegetable intake was not significant and fell short of recommended intakes. Additionally, SR-Eat positively correlated with fruit intake and change in fruit intake at weeks 10 and 14. Change in fruit intake was significant and just met the minimum recommended intake at week-14 follow-up but not at week-10. Focusing on SE and SR for fruit and vegetable intake may be a strategy for improving eating behaviors.

The results show SR-PA to have a greater influence on time spent on exercise activities and neither SR-PA nor SE-PA correlated with body weight among intervention participants. SR-PA moderately correlated with the number of minutes spent in strengthening and stretching activities per week and moderately to strongly correlate with minutes spent in aerobic activities per week at weeks 1, 10, and 14. Change in SR-PA at week-10 and 14 moderately significantly correlated with a change in minutes of aerobic exercise at the same periods. Change in SE-PA at week-10 weakly correlated with a change in minutes of aerobic exercise at week-10. The influence of the intervention on SR-PA likely influenced the significant increase in minutes of exercise seen among the intervention group.

Lastly, greater class attendance among the intervention group correlated with greater weight loss and number of minutes reported per week in aerobic exercise. More frequent class attendance likely increases adherence to use of self-regulation methods for both eating and exercise behavior. However, this study did not measure adherence to use of self-regulation methods and therefore a correlation between attendance and adherence cannot be determined.

Discussion and Implications

Importance of SE and SR

Short-term worksite weight loss intervention programs can influence ratings of SE and SR for eating and exercise behaviors as well as actual eating and exercise behaviors that result in small weight losses. This study did find a significant increase in minutes of exercise and fruit intake but not vegetable intake. In comparison to others, Touger-

Decker et al. (2008) found an increase in both fruit and vegetable intake over a 12-week intervention while Morgan et al. (2011) found no difference. However, Morgan et al. did find an increase in physical activity over a 12-week intervention similar to this study. Although results of studies are inconsistent, short-term interventions do appear promising in terms of encouraging small changes in eating and exercise behaviors. Despite significant increases, participants in this intervention fell short of meeting Dietary Guidelines for Americans fruit and vegetable intake recommendations and Center for Disease Control physical activity recommendations for resistance exercise at the end of the 10-week intervention. On average, participants did meet the minimum aerobic exercise recommendations at week-10. Longer-term interventions consistent with current evidence-based recommendations for weight loss are needed for continued behavior change that results in achieving clinically meaningful weight loss and long-term maintenance of the new health behaviors.

The effect of SE and SR for eating and exercise behaviors on weight and actual eating and exercise behaviors is uncertain. Consistent with others (Palmeira et al., 2007; Warziski et al., 2008), this study found SE-Eat and SE-PA significantly increased during a weight loss intervention. However, baseline SE-Eat and SE-PA was not associated with weight or weight loss, which is similar to finding of Byrne et al. (2012) and Fontaine and Cheskin (1997). This is contrary to others who have found baseline SE-Eat to be associated with weight loss at the time of treatment (Shin et al., 2011; Warziski et al., 2008). These interventions were longer in length, allowing more time for weight loss to be achieved and SE to be strengthened. The current study did find that an increase in SE-

Eat was significantly but weakly associated with greater weight loss at the end of the 10-week intervention. Furthermore, SE-Eat increased with the intervention, so did minutes of exercise and fruit intake. These results are similar to Annesi's (2011c) findings for a comparable community-based intervention. Interestingly, one group of researchers found conflicting results regarding higher SE and fruit and vegetable intake when comparing studies conducted at two different time points (E. S. Anderson et al., 2007; Anderson-Bill et al., 2011). More recently, a long-term group weight loss intervention found adding individual sessions to enhance SE to standard group weight loss treatment (included self-monitoring) led to similar weight loss but greater weight loss maintenance at follow-up compared to a group receiving standard group behavioral weight loss treatment only .

We can only conclude that SE-Eat may or may not influence weight or eating habits. Change in SE-Eat over the course of an intervention may be a better indicator but support for this is limited. Health educators can consider SE-Eat when planning and implementing weight management programs in the workplace, however it may not be the most influential factor in determining successful weight loss but may influence maintenance of health behavior change.

SR for eating and exercise behaviors may be better indicators for weight loss success compared to SE. This study found SR-Eat significantly correlated with weight at the time of the intervention and change in SR-Eat moderately significantly correlated with weight change at the end of the intervention. Both SR-Eat and SR-PA correlated significantly with fruit and vegetable intake and exercise behavior, respectively in the current study. Cahill et al. (2012) also found SR for eating behaviors that led to reduced calorie intake also resulted in the most weight loss success. In addition, others confirm use of SR strategies for food intake, physical activity, and weight monitoring are associated with greater weight loss, reduced calorie intake, and increased exercise behavior (Kong et al., 2012; Steinberg et al., 2015; Turk et al., 2013). SR trumps SE under conditions in which poor eating choices are available yet SE is high (E. S. Anderson et al., 2007) and use of SR strategies have been found to be the best predictor of nutrition related behavior (Anderson-Bill et al., 2011). SR-PA was more strongly correlated with exercise behavior than SE-PA in the current study; neither correlated with weight loss. Participant exercise levels did not reach levels known to aid in achieving modest weight loss, which may in part explain the lack of correlation in the current study.

Notably, SR for eating and exercise can support SE for eating and exercise and in this study SR and SE correlated respectively for eating and exercise. Annesi and Gorjala (2010) showed that use of SR for eating and exercise behaviors supported SE and therefore subsequent weight loss. In addition, greater use of SR behaviors is associated with higher levels of SE for eating and exercise behaviors and subsequent weight loss (Annesi, 2011b; Rejeski et al., 2011). The current study included use of SR strategies among intervention participants but did not track frequency of use. Weight management programs in the workplace that support and increase adherence to use of SR strategies may lead to better outcomes. Future programs may benefit from increased monitoring and evaluation of SR strategies of participants.

Health educators can incorporate multiple methods of training individuals to use SR strategies including use of external electronic tracking devices to the use of more internal mindfulness techniques for improved SR of weight management behaviors. Adherence to self-monitoring of food intake and weight are known to lead to better weight loss outcomes and are considered standard components of behavior based weight loss programs (Forman & Butryn, 2015). Electronic monitoring devices allow for immediate feedback and may be useful at the point of decision-making and therefore improve engagement and SR when incorporated into weight management programs (Hwang, Ning, Trickey, & Sciamanna, 2013; Pellegrini et al., 2012; Stephens & Allen, 2013). For example, training weight-management participants to enter calorie information about a food choice prior to intake can aid in making an appropriate decision consistent with the goal of calorie reduction for weight loss. Furthermore, mindfulness cognitive strategies aim to increase tolerance to uncomfortable feelings or thoughts related to food or physical activity and increase acceptance of a decreased sense of pleasure associated with healthier food and activity behaviors while remaining cognizant and committed to the desired personal goals and values of weight loss (Forman & Butryn, 2015). Forman and Butryn (2015) believe that clarifying values, increasing metacognitive awareness, and increasing tolerance to distress are necessary skills for lessoning the response to internal and external stimuli that promote overeating and sedentary behavior and are a means for strengthening SR that facilitates weight loss. They advocate for adding these skills to existing SR strategies in weight management programs. Evaluation of the synergistic effect of multiple SR strategies is an area needing further investigation.

Effects of Short-term Interventions

Short-term weight loss interventions that target eating and exercise behaviors and incorporate behavioral concepts can lead to statistically significant but small amounts of weight loss and changes in eating and exercise behavior. This 10-week intervention study resulted in a mean weight loss of 2.38 lbs (1.2 kg). This is consistent with similar short-term intervention studies that resulted in mean weight loss of 3.5 lbs (1.6 kg) to 4.2 lbs (1.9 kg) (Christensen et al., 2011; Thorndike et al., 2011; Touger-Decker et al., 2008). Although the mean weight loss in this study and others was statistically significant, it falls short of being clinically meaningful (weight loss greater than 5 to 10 percent) for reducing health risk factors associated with overweight and obesity. Therefore, short-term interventions are unlikely to have an effect on obesity related health concerns in the workplace.

This makes the argument for the need and support for longer-term weight loss interventions in the workplace. Ongoing initiatives will likely lead to greater success as opposed to intermittent programs or campaigns commonly seen in the workplace. To strengthen the argument, weight management guidelines for adults with overweight and obesity recommend a minimum six-month participation in a comprehensive program that promotes adherence to a reduced calorie diet, increased physical activity, and incorporates behavioral strategies that can be classified as self-regulation strategies such as self-monitoring and goal setting (Jensen et al., 2014; Raynor & Champagne, 2016). Health educators involved in planning and implementing workplace weight-management programs must implement programs sufficient in length to have clinically meaningful weight loss results. In addition to consideration for length of the intervention, attendance or intensity of the intervention also matters.

Importance of Attendance

Intervention attendance or intensity of the intervention influences outcomes. In this study and others (Byrne et al., 2012; Wadden et al., 2009) greater attendance in weight management interventions was associated with greater weight loss success as well as more frequent use of self-monitoring is associated with more weight loss (Steinberg et al., 2015; Turk et al., 2013). Weight management guidelines recommend a minimum dose of 14 sessions over six months (Jensen et al., 2014; Raynor & Champagne, 2016); short-term interventions fail to meet this recommendation. Furthermore, frequency of attendance may increase adherence to recommended dietary changes, physical activity, and use of SR strategies. Adherence to intervention recommendations may be the strongest indicator of weight loss success (MacLean et al., 2015). Health educators must develop programs and strategies that increase attendance and adherence to intervention programs in the workplace where there are often competing factors including job duties, unhealthy food environments, and lack of opportunity for physical activity. To increase adherence, MacLean et al. (2015) suggests four key strategies including increase social support, provide easy to follow dietary recommendations, training for self-monitoring skills and tools, and support for physical activity. Social support must come from more than group weight loss sessions and include support from workplace leadership and policies affecting the food and physical activity environment within the workplace. Health educators should consider how workplace social and environmental influences might affect intervention participants' ability to attend programs to achieve an adequate dose and adhere to recommendations for health behavior change.

Implications of Social Influence and Support

Overweight and obesity clusters in social networks and social influences are stronger among those of the same gender (Christakis & Fowler, 2007; Leahey et al., 2011). In addition, overweight persons are more likely to try to lose weight when a social contact is also trying to lose weight (Leahey et al., 2011). Baseline characteristic data showed that study participants had an average of nine friends who were overweight and a mean of at least four friends trying to lose weight. Our questionnaire did not distinguish whether these social contacts were co-workers or contacts outside of the workplace. Few participants perceived a direct influence of co-workers or other class participants on their own confidence and self-management of eating or exercise habits. A possible explanation for this perceived low level of social influence is because although participants may have attended the intervention with a co-worker from the same department, they may not actually interact socially with that co-worker much due to work responsibilities. In addition, even if they knew others in the intervention, they did not consider them co-workers if they were from a different department. Based on qualitative interviews, there seems to be little social interaction among participants outside of the time available for the intervention sessions. Therefore, social contacts in the workplace may not have strong enough bonds to influence SR and SE for health behaviors. This may be unique to the UT Southwestern environment and the nature of the work performed by the participants and not likely applicable to other work environments.

Comments made by interviewees regarding increased motivation when seeing others lose weight, sense of support from others like them, and a sense of competition to lose more weight may help explain findings of others. Gorin et al. (2005) and Leahey et al. (2012) found that study participants lost more weight if a social contact also lost weight and if more teammates were trying to lose weight, respectively. Social influence and support has stronger ties to outcomes in studies in which intervention participants enrolled as a group or team as opposed to an individual (Leahey et al., 2012; Rigsby et al., 2009). Likewise, high social support in the workplace is associated with increased physical activity and fruit and vegetable intake (Tamers et al., 2011). Health educators should seek and evaluate strategies to strengthen positive social influences and social support in the workplace for improving outcomes of weight loss interventions. Future interventions may benefit from adding opportunities for increasing social interaction through means of technology such as discussion forums or formal meeting times for physical activity or group meals.

Limitations

Limitations of this study include threats to both internal and external validity. First, the sample is relatively small and therefore inadequate for optimal statistical power. Second, the sample was not randomized and was made up of volunteer participants most of whom were interested in losing weight. This may have influenced motivation for weight loss. Third, there was potential for diffusion of treatment between the groups as participants of each group may have interacted in the workplace and shared information. Fourth, the participants may have been influenced by sources or events outside of the workplace. Intervention participants mentioned influence and support of family members during qualitative data collection. Fifth, there was a 24 percent dropout rate in the intervention group. Reasons for dropout are unknown and it is unknown how the intervention influenced these individuals. Sixth, the researcher conducted all components of the study including qualitative interviews. The presence of the researcher may have influenced candidness of participant responses, as they may want to please the researcher and avoid criticizing components of the program. Internal evaluation by the researcher can also introduce bias on the researcher's part, influencing the ability to evaluate critically the program components and areas for improvement. Seventh, control group members reported being influences by the study questionnaires and may have changed their behaviors as a result. Additionally, the in-class weekly sessions included learner-centered activities to reinforce behavior change concepts such as meal planning activities, personalized exercise prescriptions, and problem solving activities. Participants also set weekly goals and tracked food intake and weight during the week between classes and were asked to share how well they met their goal at the beginning of each class. However, there were no scheduled activities or planned interaction outside of the class sessions for reinforcing behavior change, which may have limited the effects of the intervention. Next, qualitative questions were lengthy and sometimes required repeating or an explanation, which may have altered responses. Furthermore, the sample included only female employees of UT Southwestern Medical Center and therefore results cannot be generalized to male employees. Lastly, the unique environment and culture of the UT

Southwestern workplace may have influenced the outcomes of this study. Therefore, we cannot expect similar results to occur under different workplace conditions.

Recommendations

Skills and competencies of health educators in the area of assessment, program planning, implementation, research and evaluation, and policy advocacy position them well for addressing future needs of weight loss health education initiatives in the workplace. Future research recommendations include evaluating factors in the workplace that influence adherence to attendance in intervention programs, use of self-regulation behaviors, strategies for increasing social interaction, and the influence of workplace policies and the environment on the ability of individuals to adhere to changes in lifestyle behaviors that influence body weight. In this study, many intervention participants reported using smartphone technology to track food and activity intake, but this use was not monitored or a formal part of the established program. A formal means of incorporating smartphone technologies such as food and physical activity tracking phone applications as an adjunct to face-to-face interaction may be a way to increase adherence to self-regulation strategies and increase social influence and support (Pelligrini et al., 2012; Raynor & Champagne, 2016). As mentioned previously, social influence and support is tied to better outcomes when participants enroll as a group (Leahey et al., 2012; Rigsby et al., 2009) and is associated with increased physical activity and fruit and vegetable intake (Tamers et al., 2011). Face-to-face interventions are considered more effective for weight loss than computerized interventions (Jensen et al., 2013; Raynor & Champagne, 2016). However, incorporating smartphone technology increases possibilities for more frequent and immediate feedback through automated tailored feedback or text messaging, accountability, ability to compare personal results to others, and social interaction through discussion forum tools among participants in weight loss programs (Raynor & Champagne, 2016). Further research is needed on the use of technology as an adjunct to face-to-face programs.

Program planning and implementation should take into account factors across all levels of influence from intrapersonal to workplace related policy and environment in future research. In addition, program planning should adhere to current recommendations of the Academy of Nutrition and Dietetics and the American Heart Association, American College of Cardiology, and The Obesity Society weight management guideline that recommend a minimum of 14 sessions within 6 months for intensive lifestyle behavioral interventions for weight loss with up to a year follow-up. Currently few workplace initiatives meet the recommendations for evidence-based weight loss interventions. In addition, evaluation of group-based lifestyle interventions paired with broader policy and environmental changes within the workplace are necessary to determine if the synergy of multiple levels of influence indeed support better health outcomes. Another possible area of research is how workplace related stress and morale influences adherence and weight loss success of individuals who enroll in weight loss interventions in the workplace. Moreover, health educators can use their skills in evaluating and applying concepts of health behavior theories to better understand motivation at the individual level and why some adhere to weight loss recommendations and make changes to their environment, while others do not despite reporting being inspired or motivated to do so.

Finally, there is a need for new validated tools for evaluating SE and SR. Existing tools focus on avoidance and control of unhealthful eating, primarily overeating, in challenging situations instead of the adoption of multiple healthful eating behaviors under more favorable circumstances (Ames et al., 2012; Annesi, 2011c). This may lead to an incomplete assessment of an individual's SE or SR for health behaviors and a focus on negative outcomes. Using competencies in assessment and management of health education, the health educator can assist in developing new assessment tools and organize teams of health professionals with the expertise to address these future research needs.

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APPENDIX A

Modified 10-week Group Lifestyle Balance Program

Modified 10-week Group Lifestyle Balance Program Outline of Curriculum

Session 1: Welcome to the program: Setting your weight loss goal and monitoring food intake

Session 2: Food label reading: Finding excess fat and calories

Session 3: Defining healthy eating: Using MyPlate and Dietary Guidelines

Session 4: Moving your muscles: Establishing your personalized exercise prescription

Session 5: Tipping the calorie balance in your favor

Session 6: Take charge of your surroundings: Setting up your environment for success and social cues

Session 7: Problem solving: Finding solutions to triggers and unexpected events

Session 8: Keys to making healthy decisions when eating out

Session 9: Slippery slope of lifestyle change: Dealing with setbacks and relapse

Session 10: Staying motivated for continued success

APPENDIX B

Weekly Weight Tracking Form

Weekly Weight Tracking Form

Name: ___________________________________

Age: _____ Height: ______

Week	Weight (lbs.)	BMI (wks 1 & 10)	Weight change
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

APPENDIX C

Demographics Questionnaire

Demographics Questionnaire

Please respond to the following questions. Your responses to these questions will be kept confidential.

Please enter your age: _______ Check the correct box: ☐ Female ☐ Male

1. What is your job title? ____________________________

2. Have you participated in a weight loss program in the past?

   _____ Yes _____ No

3. If you answered yes to question 3, which weight loss programs have you tried before? (check all that apply)
   _____ Weight Watchers
   _____ Jenny Craig
   _____ Nutrisystems
   _____ Slim for Life
   _____ Other(s) ________________________

4. If you lost weight using another weight loss program in the past, how much weight did you lose?
   _____ less than 5 pounds
   _____ 5 to 10 pounds
   _____ 11 to 15 pounds
   _____ 16 to 20 pounds
   _____ 21 to 25 pounds
   _____ 26 to 30 pounds
   _____ 31 pound or more

5. If you indicated that you lost weight in question 4, did you keep this weight off?
   _____ Yes _____ No

6. How many close friends or family members do you know who are overweight?

   _____

7. How many close friends or family members do you know who are actively trying to lose weight?

   ______

8. Did a friend or co-worker encourage you to participate in the worksite weight-loss program?
   ____ Yes   _____ No

9. Is a friend or co-worker participating in the worksite weight-loss program with you?
   _____ Yes   _____ No

10. Are you willing to participate in an interview about how social influences may affect your lifestyle habits and weight loss at the end of the worksite weight-loss program?
    _____ Yes   _____ No

APPENDIX D

Weight Efficacy Lifestyle Questionnaire

Weight Efficacy Lifestyle Questionnaire Short Form

Weight Efficacy Lifestyle Questionnaire Short-Form (WEL-SF)
Read each situation below and decide how confident (or certain) you are that you will be able to resist overeating in each of the difficult situations. On a scale of 0 (not confident) to 10 (very confident), choose ONE number that reflects how confident you feel now about being able to successfully resist the desire to overeat. Write this number next to each item.

0	1	2	3	4	5	6	7	8	9	10
Not at all confident										**Very** Confident

I AM CONFIDENT THAT:	Confidence Number
1. I can resist overeating when I am anxious (or nervous).	________
2. I can resist overeating on the weekend.	________
3. I can resist overeating when I am tired.	________
4. I can resist overeating when I am watching TV (or using the computer).	________
5. I can resist overeating when I am depressed (or down).	________
6. I can resist overeating when I am in a social setting (or at a party).	________
7. I can resist overeating when I am angry (or irritable).	________
8. I can resist overeating when others are pressuring me to eat.	________

APPENDIX E

Physical Activity Appraisal Inventory

Physical Activity Appraisal Inventory (PAAI)

Directions: Using the 0-100 scale below, please rate how sure you are that you can perform your usual physical activities regularly under the following conditions. Physical activity refers to all activity at home, work, or leisure.

0	10	20	30	40	50	60	70	80	90	100
Cannot do at all					Moderately certain can do					Certain can do

I am confident that I can perform my usual physical activities (includes all activity at home, work, or leisure): (0-100)

1. When I am feeling tired _____

2. When I am feeling pressure from work or school ______

3. During bad weather ______

4. During or after experiencing personal problems ______

5. When I am feeling depressed ______

6. When I am feeling anxious ______

7. When I feel physical discomfort with an activity ______

8. When I have too much work to do at home ______

9. When I/we have visitors ______

10. When there are other interesting things to do _____

11. When I don’t have support from my family or friends ______

12. When I have other time commitments ______

13. When I do not feel well ______

APPENDIX F

Self-regulation for Eating Questionnaire

Self-regulation for Eating

Please fill in the blanks indicating (1 to 4) how often you currently do each of the following. Please refer to the scale below. Your answers will be kept strictly confidential.

1 = Never
2 = Rarely
3 = Occasionally
4 = Often

1. I make formal agreements with myself regarding my eating. ………. _____
2. I schedule my times to eat. …………………………………………. _____
3. I say positive things to myself about eating well. …………………... _____
4. I set eating goals. …………………………………………….……. _____
5. I choose healthy foods that are enjoyable to me. …………………… _____
6. I keep a record of my eating. ……………………………………….. _____
7. I try to recruit others to support my eating plans. …………………... _____
8. I reward myself for eating appropriately. …………………………… _____
9. When I get off-track with my eating plans, I work to quickly get back to my routine. …………………………………………………….. _____
10. I purposefully address my barriers to eating appropriately. ………..... _____

APPENDIX G

Self-regulation for Physical Activity Questionnaire

Self-regulation for Physical Activity

Please fill in the blanks indicating (1 to 4) how often you currently do each of the following. Please refer to the scale below. Your answers will be kept strictly confidential.

1 = Never 2 = Rarely 3 = Occasionally 4 = Often

1. I keep track of my physical activity mentally or by recording it. _____
2. I mentally note specific things that help me be active. _____
3. I set short-term goals for how often I am active. _____
4. I set physical activity goals that focus on my health and fitness level. _____
5. I ask a friend/co-worker/family member to be physical activity with me. _____
6. I ask a physical activity expert or health professional for physical activity advice or demonstration. _____
7. After physical activity, I say positive things to myself and focus on how good I feel. _____
8. I remind myself of the health benefits I will get from being physically active instead of focusing on the hassles of being active. _____
9. I schedule specific times for physical activity. _____
10. I choose convenient physical activities that fit within my schedule. _____
11. I purposely plan ways to make physical activity more enjoyable such as trying new activities. _____
12. I make backup plans to be sure I get my physical activity. _____
13. When I get off track with my physical activity plans, I tell myself I can start again and get right back on track. _____

APPENDIX H

Cups per Day Fruit and Vegetable Screener

Cups per Day Fruit and Vegetable Screener

The next two questions ask about cups of fruits and vegetables you eat or drink each day. The following boxes provide some examples of how much counts as one cup.

1 cup of fruit could be:	**1 cup of vegetables could be:**
1 small apple 1 large banana 1 large orange 8 large strawberries 1 medium pear 2 large plums 32 seedless grapes 1 cup (8 oz.) of 100% fruit juice ½ cup of dried fruit 1 small wedge of watermelon (1 inch thick)	3 broccoli spears, 5 in. long 1 cup of cooked leafy greens 2 cups of lettuce or raw greens 12 baby carrots 1 medium potato 1 large sweet potato 1 large ear of corn 1 large ear of corn 1 large raw tomato 2 large celery stalks 1 cup of cooked beans

1. About how many cups of fruit (including 100% pure fruit juice) do you eat or drink each day? (X only one)

None …………..☐ ½ to 1 cup ……..☐ 2–3 cups ……….☐ 4 cups or more….☐
½ cup or less …..☐ 1–2 cups ……….☐ 3–4 cups ……….☐

2. About how many cups of vegetables (including 100% vegetable juice) do you eat or drink each day? (X only one)

None …………..☐ ½ to 1 cup ……..☐ 2–3 cups ……….☐ 4 cups or more….☐
½ cup or less …..☐ 1–2 cups ……….☐ 3–4 cups ……….☐

APPENDIX I

Exercise Behaviors

Exercise Behaviors

During the past week, even if it was not a typical week for you, how much **total** time (for the **entire week**) did you spend on each of the following? (Please circle **one** number for each question.)

	None	**Less than 30 min/wk**	**30-60 min/wk**	**1-3 hrs/wk**	**More than 3 hrs/wk**
1. Stretching or strengthening exercises (range of motion, using weights, etc.)	**0**	**1**	**2**	**3**	**4**
2. Walk for exercise	**0**	**1**	**2**	**3**	**4**
3. Swimming or aquatic exercise	**0**	**1**	**2**	**3**	**4**
4. Bicycling (including stationary exercise bikes)	**0**	**1**	**2**	**3**	**4**
5. Other aerobic exercise equipment (Stairmaster, rowing, skiing machine, etc.)	**0**	**1**	**2**	**3**	**4**
6. Other aerobic exercise Specify___________________ ________	**0**	**1**	**2**	**3**	**4**

APPENDIX J

Qualitative Questionnaire for Semi-structure Interviews

Qualitative Questionnaire for Semi-structure Interviews

Purpose

The purpose of the semi-structured interviews is to aid in explaining quantitative results and to better understand how social influence of co-workers may affect quantitative changes in self-efficacy and self-regulation for eating and exercise behaviors, fruit and vegetable intake, and exercise frequency.

Objectives

1. To identify factors of social influence that affect self-efficacy for eating and physical activity behaviors.
2. To identify factors of social influence that affect self-regulation for eating and physical activity behaviors.
3. To identify factors of social influence that affect nutrition and physical activity behaviors.

Interview Welcome and Instructions Script

Welcome and thank you for taking the time to participate today. This interview will take about 45 minutes and will include eight questions regarding the social influence of co-workers on your confidence to perform healthy eating and physical activity behaviors. Questions will also ask about how social influence of co-workers affected your motivation, effort, emotions, goal setting, and self-monitoring. I would like to ask your permission to audio record this interview, so I can accurately document your comments. At any time if you wish to stop the recording or the interview itself, please feel free to let me know. All of your responses will be kept confidential. The purpose of this part of the study is to better understand how social influence of co-workers may affect quantitative changes in self-efficacy and self-regulation for eating and exercise behaviors, fruit and vegetable intake, and exercise frequency.

Interview Form

Participant # ______ Time: _____ Date:__________

Questions	**Response Notes**
1. Did you participate in the worksite weight-loss program with a co-worker you knew prior to the start of the program? *Additional prompts:* How well do you know this co-worker? How did knowing the co-worker influence you? How did not having a co-worker participate influence you?	
2. Did a co-worker you know participate in a previous version of the program? *Additional prompts:* How well do you know this co-worker?	

How did knowing a co-worker that participated in a prior version of the program influence your decision? How did not knowing a co-worker who participated influence you?	
3. How did being part of the worksite weight-loss program with co-workers influence your confidence in your ability to make healthier eating choices under difficult circumstances such as stress, time constraints, unplanned changes in schedules, or access to high fat, high calorie foods? *Additional prompts:* Please provide an example of how a co-worker may have influenced you. How did being part of the worksite weight-loss program without co-workers influence your confidence in your ability to make healthier eating choices under difficult circumstances	

such as stress, time constraints, unplanned changes in schedules, or access to high fat, high calorie foods?	
4. How did being part of the worksite weight-loss program with co-workers influence your confidence in your ability to participate in regular physical activity under difficult circumstances such as stress, time constraints, unplanned schedule changes, bad weather, poor mood, or feeling tired? *Additional prompts:* Please provide an example of how a co-worker may have influenced you. How did being part of the worksite weight-loss program without co-workers influence your confidence in your ability to participate in regular physical activity under difficult circumstances such as stress, time	

constraints, unplanned schedule changes, bad weather, poor mood, or feeling tired?	
5. Describe how being part of the worksite weight loss program with co-workers influenced your ability to overcome barriers to making healthier eating habits. Describe how being part of the worksite weight loss program with co-workers influenced your ability to overcome barriers to making healthier eating habits. Describe how being part of the worksite weight loss program without a co-worker influenced your ability to overcome barriers to making healthier eating habits? *Additional prompts:* Barriers may include time constraints, food preferences, cooking skills, and easy access to less	

healthy food choices. Please explain further. Is there anything else?	
6. Describe how being part of the worksite weight loss program with co-workers influenced your ability to overcome barriers to changing physical activity habits. Describe how being part of the worksite weight loss program without a co-worker influenced your ability to overcome barriers to changing physical activity habits. *Additional prompts:* Barriers may include time constraints, attitude toward physical activity, lack of knowledge or skills for physical activity, and commitments to family. Please explain further. Is there anything else?	

7. Describe how being part of the worksite weight loss program with co-workers influenced your nutrition habits. Describe how being part of the worksite weight loss program without a co-worker influenced your nutrition habits. *Additional prompts:* Please provide an example of how your nutrition habits changed. Is there anything else?	
8. Describe how being part of the worksite weight loss program with co-workers influenced your physical activity habits. Describe how being part of the worksite weight loss program without a co-worker influenced your nutrition physical activity habits. *Additional prompts:*	

Please provide an example of how your physical activity habits changed. Is there anything else?	
9. Describe how being part of the worksite weight loss program with co-workers influenced your effort or motivation to lose weight. Describe how being part of the worksite weight loss program without co-workers influenced your effort or motivation to lose weight. *Additional prompts:* Please explain further. Is there anything else?	
10. Describe how being part of the worksite weight-loss program with co-workers influenced your own goal setting and monitoring of weight management behaviors. Describe how being part of the worksite weight-loss program without co-	

workers influenced your own goal setting and monitoring of weight management behaviors. *Additional prompts:* Please explain further. Is there anything else?	
11. Describe how being part of the worksite weight loss program with co-workers influenced your attitude and thoughts related to making lifestyle changes for weight loss. Describe how being part of the worksite weight loss program without co-workers influenced your attitude and thoughts related to making lifestyle changes for weight loss? *Additional prompts:* Please provide an example of thoughts or attitudes influenced. Is there anything else?	

Interview Notes: