Abstract

Early Dieting Related to Disordered Eating and Weight Loss in a Behavioral Weight Loss Intervention

Objective: The current study conducted a secondary analysis of data from a 12-month behavioral weight loss program to examine if there was a differential trend in percent weight loss from three months to 12 months as a function of age of first diet attempt and disordered eating behaviors. The study also examined whether the age of first diet attempt is related to the self-reported use of disordered eating behaviors.

Participants and Methods: Participants were recruited from a Health Maintenance Organization to participate in a 12-month behavioral weight loss intervention. Participant's (n=424) demographic variables, weight at baseline, three months, and 12 months, and self-report data from the Questionnaire on Eating and Weight Patterns was used to inform the analyses. The planned statistics within this proposal (i.e., a mixed-design ANCOVA) allowed for an examination of the differential trends in percent weight loss over time (i.e., at three months; 12 months) as they related to the subject characteristics (i.e., disordered eating behaviors; age of first diet attempt) that may influence the efficacy of behavioral weight loss interventions for a subset of participants. A chi square was used to examine the relationship between self-reported age of first diet attempt and disordered eating behaviors.

Results: There was no evidence of a differential trend of percent weight loss at three months and between three and 12 months as a function of age of first diet attempt $F(4, 408) = .023$, $p = .896$. and eating disordered behaviors $F(1, 417) = .046$, $p = .831$. There was a differential trend in percent weight loss as a function of the type of intervention the participants received. The results revealed

a significant relationship between the age of first diet attempt and the use of disordered eating behaviors $X^2(4) = 34.13$, $p < .01$.

Conclusions: The age of first diet attempt and the use of disordered eating behaviors were not related to weight loss at three months and 12 months. Participants within the computer/intervention conditions lost significantly more weight between baseline and three months than three months to 12 months. Dieting age was related to participants using disordered eating behaviors.

Early Dieting Related to Disordered Eating and Weight Loss in a Behavioral Weight Loss Intervention

By
Astrid Marcus Insull

Submitted in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy
in the Ferkauf Graduate School of Psychology
Yeshiva University
January, 2023

The committee for this dissertation consists of:

Charles Swencionis, Ph.D., Chairperson

Ferkauf Graduate School of Psychology, Yeshiva University

Albert Einstein College of Medicine

Judith Wylie-Rosett, Ed.D.

Albert Einstein College of Medicine

Andrea Weinberger, Ph.D.

Ferkauf Graduate School of Psychology, Yeshiva University

The readers for this doctoral dissertation include:

Bari Hillman, Ph.D.

Ferkauf Graduate School of Psychology, Yeshiva University

Willo Wisotsky, Ph.D.

New York Bariatric Group

Acknowledgments

I would like to express my deep gratitude and appreciation for the support and encouragement from my mentors, classmates, mother, and husband for undertaking this journey with me over the last five years.

Firstly, Dr. Charles Swencionis, the chair of my committee: thank you so much for all of the time and energy you have invested in my professional and personal development. You have compassionately supported me through the ups and downs of graduate school and have shared your immense knowledge and humor along the way. I will forever be grateful to know you. Dr. Andrea Weinberger: you are an incredible professor and researcher who I have admired since my first semester at Ferkauf. Your guidance, support, thoughtfulness, and feedback is greatly appreciated. Dr. Judith Wylie-Rosett: this dissertation would not have been possible without you. Thank you for your dedication and passion for research, for sharing your data, and for your wisdom throughout this process. Dr. Bari Hillman: you have been an immense support to me and I am incredibly grateful for your warmth, commitment, insight, and many advice filled phone calls. Dr. Willo Wisotsky: you were one of the best supervisors I have ever had - your enthusiasm with your work has inspired me to continue to put my research into practice beyond graduate school. To my fellow lab members and cohort peers: the genuine friendships created over the laughter and tears will forever remind me how lucky I am to be surrounded by such wonderful humans.

Lastly, I would like to thank the love of my life, my husband, Trent Insull. I truly could not have gotten through graduate school without your unwavering and unconditional support,

kindness, patience, friendship, and love. Thank you for the late-night statistics tutoring and thank you for always believing in me, even when I did not always believe in myself.

Dedication

To my mom, Dr. Ivy Marcus: you were my first friend, you are my best friend, and you will always be my forever friend. I was around 6 years old when I started answering the question "what do you want to be when you grow up" with "I want to be a psychologist." Six-year-old me definitely did not know exactly what that entailed but I did know it meant "I want to be just like my mom when I grow up." Now, about 20 years later, the biggest compliment anyone can ever give me is that I am just like you. Completing this dissertation project puts me one step closer to finally accomplishing this lifelong goal and following in your footsteps. You inspire me every day, you are the best role model I could ever wish for, and you are truly the best mom. Thank you from the bottom of my heart for all of the support and love you have provided throughout my entire life. I truly could not have done any of this without you.

Table of Contents

List of Tables

List of Figures

Chapter I

Chapter I: Introduction

Obesity

The prevalence of adult individuals in the United States with overweight and obesity is growing (Wang et al., 2020). Overweight is defined as having a body mass index (BMI) of 25 to 29.9kg/m2 and obesity is defined as a BMI of ≥30 kg/m2 (Chang, 2016; Hamarashid, 2020; National Heart, Lung, and Blood Institute, 2013). Current estimates indicate that 69 percent of adults are either overweight or obese, with approximately 42.4 percent of adults classified as being obese (Flegal et al., 2012; Hales et al., 2018; Wang et al., 2020). By 2030, 78 percent of American adults are projected to be overweight or obese (Wang et al., 2020). Excess weight is associated with serious health risks (Hales et al., 2018). For example, obesity raises the risk for morbidity from hypertension, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea and respiratory problems, and certain cancers (Hamarashid, 2020; National Heart, Lung, and Blood Institute, 2013). Additionally, obesity is the second leading cause of preventable death in the United States, following cigarette smoking (Wang et al., 2018) The biomedical, psychosocial, and economic influence of obesity has extensive consequences for the well-being and overall health of the United States population (Chang, 2016).

Behavioral Weight Loss Interventions

Research has revealed losing weight can prevent the development of the chronic conditions related to obesity (e.g., type 2 diabetes) or at least lead to improved control over them (Appel et al., 2003; Linde et al., 2016). Specifically, even a two to three percent reduction in body weight

can lead to improved health outcomes (Jensen et al., 2013; Lemstra et al., 2016). Behavioral weight loss interventions focus on lifestyle changes among a variety of aspects of a person with overweight or obesity's life including diet and exercise (Perri et al., 2016; Yannakoulia et al., 2019). People with overweight and obesity receive the greatest weight loss benefit from a minimum of a 6-month, high intensity, weight loss program with a trained interventionist (Butryn et al., 2011; Wadden et al., 2020). *Obesity Guidelines* recommend an additional 6 months, totaling a 1-year weight-loss maintenance program (Wadden et al., 2020).

Past studies have demonstrated the efficacy of behavioral weight loss interventions for people classified as overweight and obese (Butryn et al., 2011; Perri & Corsica, 2002; Wadden et al., 2020). However, weight regain subsequent to initial weight loss remains a significant problem (Wilfey et al., 2018). Weight cycling (i.e., weight regain subsequent to weight loss) is problematic due to its well-known negative health consequences, such as higher mortality due to cardiovascular disease, diabetes, and hypertension (Rhee et al., 2018; Zou et al., 2019;). Thus, behavioral weight loss interventions would benefit from identifying individuals most at risk for slowed weight losses or early weight regain during a weight loss intervention.

Predictors of Weight Loss

Overall, research has found that early weight loss success is predictive of long-term weight loss success during behavioral weight loss interventions (Unick et al., 2015). It is notable, however, that there seems to be a subset of participants for which this result does not hold true. Past studies have illustrated that elevated weight variability, defined as inconsistent weight loss, early in a weight loss program (i.e., 3 months) predicted poor long-term outcomes (i.e., 12 and 24

months), possibly reflecting inconsistent weight control behaviors (Benson et al.. 2020; Feig & Lowe, 2017). Specifically, consistent smaller week-to-week weight reductions early in treatment predicted greater long-term weight loss (Benson et al.. 2020; Feig & Lowe, 2017). Conversely, participants who had greater weight loss variability earlier in treatment predicted lesser long-term weight loss despite larger initial weight loss (Benson et al.. 2020; Feig & Lowe, 2017). Such research suggests that there may and are likely to be, other yet to be determined characteristics that cause both greater initial weight loss and poorer long-term weight control among a subset of individuals (Benson et al.. 2020; Feig & Lowe, 2017).

Other Potential Predictors of Weight Loss

Biological Variables: Prior research has demonstrated that susceptibility to obesity is partly determined by genes, as are body weight and composition changes (Pietilainen et al., 2012). Obesity among children and adolescents is likely to persist into adulthood as the number of fat cells increase most rapidly during late childhood into puberty. After puberty, the adipocyte number and size become fixed rendering it difficult to lose weight and maintain weight loss (Bray & Bouchard, 2008; Holtrup et al., 2017). The average age of puberty onset is approximately 11 years old (Ma et al., 2019). While genetics play an important role in the development and persistence of overweight and obesity from childhood into adulthood, results from a study of 4,129 twins found that frequent self-reported intentional weight loss episodes reflected a susceptibility to weight gain irrespective of genetic factors (Pietilainen et al., 2012). Thus, there is evidence to suggest that dieting in and of itself may promote weight gain independent of genetic effects among weight loss (Pietilainen et al., 2012).

Age of First Dieting Attempt: The prevalence of overweight and obesity among children and adolescents has reached approximately 18 percent, quadrupling within the last 40 years (NCD-RisC, 2017). A large proportion of the child and adolescent population with overweight and obesity report engaging in behaviors in order to attempt to reduce their body weight (Vlahoyiannis & Nifli, 2020). Research has shown that a frequent self-reported number of intentional weight loss episodes reflects susceptibility to weight gain (Field et al., 2007; Kroke et al., 2002; Pietilainen et al., 2012). energy-restricted weight loss can explain the body's tendency to regain weight due to changes in metabolic characteristics of adipose tissue (MacLean et al., 2015). Following weight loss, one's resting metabolic rate slows; thus, one's body burns less calories in a day through their metabolism than previously, often leading to weight regain (Fothergrill et al., 2016). Additional physiological changes that occur subsequent to weight loss that predispose individuals to regain weight include reductions in fat-free mass and changes in hunger and fullness regulating hormones such as leptin and ghrelin (Anastasiou et al., 2015; Poulimeneas et al., 2018). Additionally, early weight loss attempts reflect an increase in susceptibility to developing disordered eating behaviors and an increase in the adoption of short-term weight loss solutions (Neumark-Sztainer et al., 2007). These short-term weight loss mechanisms have been found to predict weight gain after weight loss attempts (Neumark-Sztainer et al., 2007). Significant clinical data has shown that most dieters rapidly re-gain achieved weight loss, and sometimes gain even more than they lost (Pietilainen et al., 2012).

Disordered Eating Behaviors: Disordered eating behaviors are defined as engaging in self-induced vomiting after eating to avoid gaining weight, taking more than the recommended dose of a laxative to avoid gaining weight, taking more than the recommended dose of a diuretic to avoid

gaining weight, taking more than the recommended dose of a diet pill in order to avoid gaining weight, fasting or not eating anything at all for at least 24 hours to avoid gaining weight, and/or exercising excessively or exercising even though it interfered with important activities / after being injured to avoid gaining weight (Racine et al., 2018; Spitzer et al., 1992; Yanovski et al., 2015). A longitudinal study found that early weight control behavior had the greatest influence on the development of disordered eating behaviors among adults in the United States (Appel et al., 2003). Engaging in extreme dieting behaviors (including over exercising, restriction, purging, laxatives, etc.) has been shown to be associated with overall less success with losing weight (Vlahoyiannis & Nifli, 2020). It has also been noted that using disordered eating behaviors, such as using diuretics, diet pills, laxatives, and vomiting, is associated with periods of restriction leading to uncontrolled overeating and subsequent weight gain (Dulloo & Montani, 2015).

Past Findings from this Dataset

This research project presents analyses from 466 completers during their weigh-ins at baseline, three months, and 12 months, as well as baseline data from the completers. The clinical trial included three levels of intervention intensity for providing cognitive behavioral weight control intervention. Conditions included a "do-it-yourself" workbook-only control group, a workbook plus computer group, and the most intensive intervention being the workbook plus computer and staff intervention group. A number of findings have been published from this clinical trial.

Relevant findings from this dataset include the following studies. Wylie-Rosett et al. (2001) sought to evaluate the cost and effects of various components of this behavioral weight loss intervention. Wylie-Rosett (2001) found that intervention variables that correlated with weight

loss included more computer log-ons, achieving computer-selected goals, more self-monitoring, increased walking, and decreased energy and fat intake.

Rubinstein et al. (2010) separately examined whether participants' history of attempting weight loss before the age of 12 was associated with the development of binge eating disorder, as well as the use of disordered eating behaviors later in life. Rubenstein et al. (2010) found that weight loss attempts in childhood may be a risk factor for the development of binge eating disorder in adults, and that weight loss attempts in childhood were associated with the development of disordered eating behaviors in adulthood.

Swencionis et al. (2013) aimed to determine the triggers of lapse and relapse of diet and exercise in behavioral weight loss. Swencionis et al. (2013) discovered that at nine months, diet triggers were negative emotional states and urges. Additionally, Swencionis et al. (2013) found that weight change at twelve months was associated with higher overall psychological well-being, lower levels of anxiety and depression, and higher positive well-being, self-control, and vitality. Vitality was found to be the best predictor of weight change at twelve months.

Finally, Phillipson et al. (2020) aimed to explore the relationship between participants' dieting histories in relation to the most amount of weight they have lost pre-intervention, self-efficacy scores to complete an intervention, readiness for weight change pre-intervention, and weight change at the conclusion of a 12-month behavioral weight loss program. Additionally, Phillipson et al. (2020) explored the relationship between self-efficacy scores and readiness for weight change scores as they related to weight change post-intervention. This study found that a history of more dieting was associated with greater past weight loss but less weight loss during the 12-month behavioral weight loss program. Self-efficacy scores pre-intervention had no effect on weight change post-intervention. Readiness for weight change had no effect on weight change post

intervention (Phillipson et al., 2020). All together, research from this clinical trial has show significant results in terms of baseline data, as well as intervention type, being related to weight loss outcomes. However, these studies do not look at weight loss trajectories over time.

Significance and Innovation

Overall, research has found that early weight loss success is predictive of long-term weight loss success during behavioral weight loss interventions (Unick et al., 2015). It is notable, however, that there seems to be a subset of individuals for which this result does not hold true. Specifically, past studies have illustrated that elevated weight variability early in a weight loss program (at three months) predicted poor long-term outcomes (at 12 and 24 months), possibly reflecting inconsistent weight control behaviors (Feig & Lowe, 2017). This weight loss pattern is problematic due to the known adverse health effects related to weight cycling (Zou et al., 2019; Rhee et al., 2018). Research has noted that other, yet to be determined, characteristics may cause early weight loss success followed by poorer long-term weight control (Benson et al., 2020; Feig & Lowe, 2017). Thus, there remains a gap in the literature addressing what variables may be associated with inconsistent weight trajectories during a 12-month weight loss intervention (Feig & Lowe, 2017). The purpose of this intervention is to better understand factors related to weight loss trajectories to better tailor weight loss interventions for subsets of participants.

The current study conducted a secondary analysis of clinical trial data from a 12-month behavioral weight loss program to examine whether the age of self-reported first dieting attempt (i.e., ages <12, 13-19, 20-29, 30-39, > 40) and the self-reported use of disordered eating behaviors (1 or more versus none: vomiting, laxative, diuretic, diet pill, fasting, exercising excessively) could be characteristics related to initial weight loss success but poor overall weight loss success. The

current study also examined whether the age of first diet attempt is related to the number of self-reported disordered eating behaviors.

The planned statistics within this proposal (i.e., a mixed design ANCOVA) allowed for an examination of the differential trends in weight loss over time (i.e., at three months and 12 months) as they related to the subject characteristics (i.e., disordered eating behaviors and age of first diet attempt) that may influence the efficacy of behavioral weight loss interventions for a subset of participants. Early identification of individuals most at risk for early losses followed by slowed loss / weight regain would allow for potential benefits from more tailored interventions (Feig & Lowe, 2017).

Should the current study find that those who dieted from a younger age and currently use disordered eating behaviors have larger initial weight losses followed by poorer long-term weight control success, behavioral weight loss interventions could target the specific physiological and psychological challenges that those participants might face (Field et al., 2007; Kroke et al., 2002; Marginean et al., 2018; Pietilainen et al., 2012; 2007; Vlahoyiannis & Nifli, 2020). Specifically, future behavioral weight loss interventions might need to initially emphasize a strong psychoeducational component focusing on the benefits of consistent, steady weight loss behaviors and the avoidance of extreme and overly rigorous weight loss behaviors. Additionally, if participants who self-reported dieting from younger ages lose more weight in the first three months of treatment, but their weight loss eventually slows or reverses before the end of treatment, behavioral weight loss interventions could benefit from including a focus on such individuals to educate them on their unique challenges regarding the behaviors that could likely induce their body's biological mechanisms to defend adiposity and reinforce slow and steady weight loss (Anastasior et al., 2015; Fothergrill et al., 2016; MacLean et al., 2015; Poulimeneas et al., 2018).

Given the chronicity of obesity, it is likely time-limited behavioral weight loss interventions may not be ideal for people who have been attempting weight loss since childhood. Instead, this population might better benefit from a longer-term treatment duration with more frequent points of accountability from health care providers. This approach could contribute to participants developing consistent habits regarding physical activity and food intake (Wilfey et al., 2018).

Specific Aims

Aim 1: To determine if age of first dieting attempt and disordered eating behaviors are related to short- and long- term weight control success within a 12-month behavioral weight loss intervention.

- *Hypothesis 1:* There will be a relationship between self-reported age of first dieting attempt and weight lost at three months and 12 months, while controlling for treatment condition. It is hypothesized that participants who self-reported dieting earlier will
    - *1a:* lose more weight in the first three months of the intervention than people who initiated dieting later in life.
    - *1b:* lose less weight at the end of the intervention than people who initiated dieting later in life.
- *Hypothesis 2:* There will be a relationship between the report of self-reported disordered eating behaviors used and the weight loss at three months and 12 months, while controlling for treatment condition. It is hypothesized that participants who report disordered eating behaviors will
    - *2a:* lose more weight in the first three months of the intervention than people who reported no disordered eating behaviors

- *2b:* lose less weight at the end of the intervention than people who reported no disordered eating behaviors.

Aim 2: To determine whether the self-reported age of first diet attempt is related to the number of self-reported use of disordered eating behaviors.

- Hypothesis 3: There will be a significant relationship between self-reported age of first diet attempt and the number of disordered eating behaviors, such that the younger a participant reported their first diet attempt, the more likely they will be to report the use of disordered eating behaviors.

Chapter II: Method

Research Methods and Design

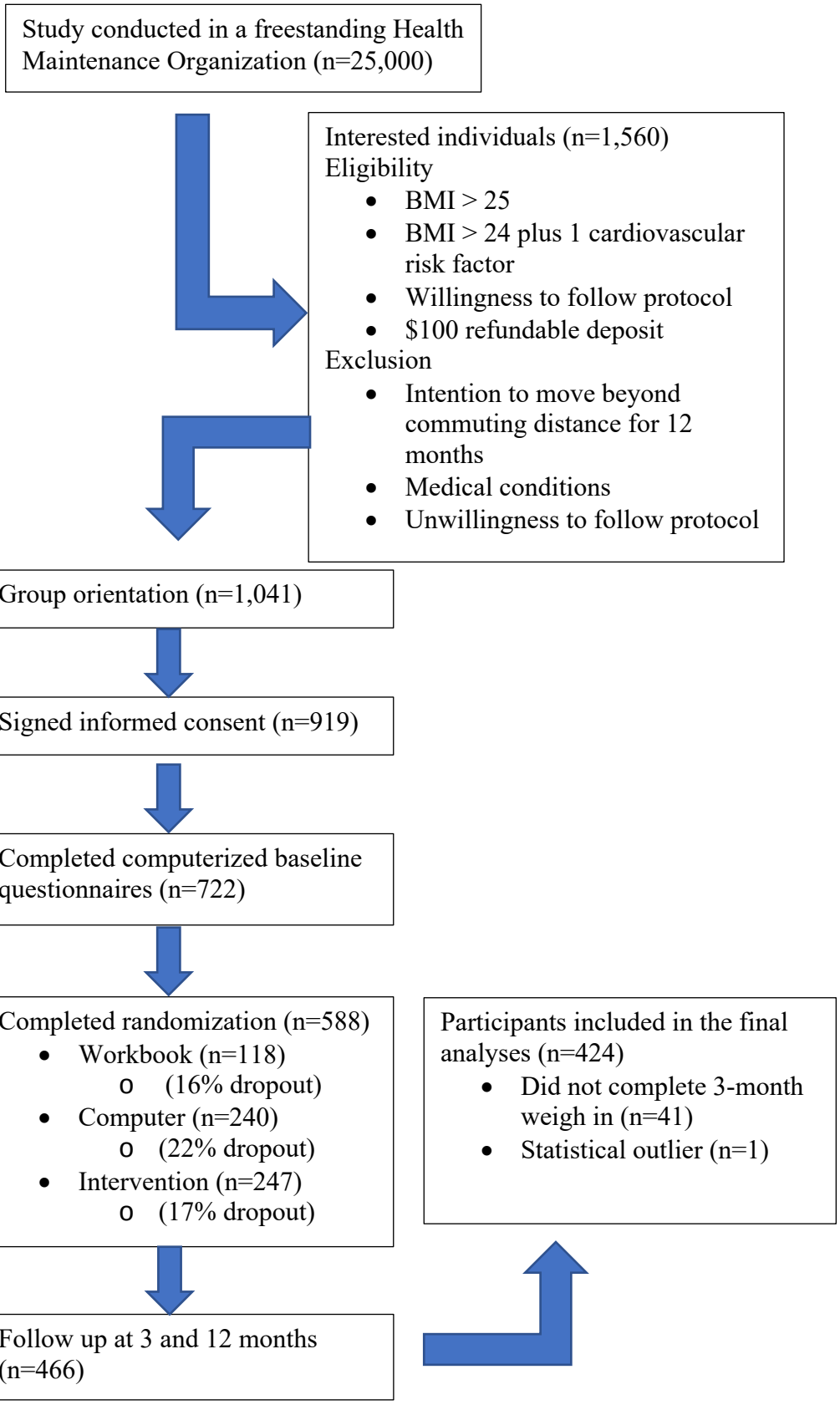
The parent study was conducted from 1993-1998 in a freestanding Health Maintenance Organization (HMO) in New York, with approximately 25,000 patients enrolled. Participants were recruited from the HMO as well as the surrounding community (i.e., Long Island, New York). For 12 months, participants were followed and assessed as part of an evaluation for a weight loss intervention conducted at the Albert Einstein College of Medicine – Long Island campus. The study was a clinical trial that focused on nutrition, fitness and psychobehavioral content as it related to weight loss. The clinical trial included three levels of intervention intensity for providing cognitive behavioral weight control intervention. Conditions included a "do-it-yourself" workbook-only control group, a workbook plus computer group (with computers available at Kiosks provided by the study), and the most intensive intervention being the workbook plus computer and staff intervention group. This research project presents analyses from completers during their weigh-ins at baseline, three months, and 12 months, as well as baseline data from the completers. Intervention status was accounted for in the data analyses as a covariate. The study protocol was reviewed by the Albert Einstein College of Medicine Institutional Review Board.

Participants*:* Participants (N = 588) were recruited by physician referrals, newsletter articles, flyers, community advertisements, local media, and news coverage to participate in a 12-month behavioral weight loss program. Informed consent was obtained from all participants. The

466 participants who completed the 12-month weight loss program were included in this study. Of the participants at baseline, 80% completed the 12-month study. Those who completed the study did not differ significantly from the participants who did not complete the study, with respect to baseline characteristics. For more detailed information, Wylie-Rosett et al. (2001) outlines the recruitment and selection process. Of the 466 participants, 41 participants did not get weighed at 3 months and one participant did not complete the relevant questionnaire data. Thus, the analyses have 424 participants included.

Inclusion/Exclusion Criteria: To be eligible for the parent study, participants had to have a BMI greater than 25 or have a BMI greater than 24 in addition to a cardiovascular risk factor. Additionally, participants had to be willing to follow the study's protocol, which included a refundable $100 deposit returned at completion. Exclusion criteria included the following: intentions to relocate in the next 12 months to a location that would interfere with participants' ability to commute to the weight program; medical conditions that would not allow for participation in the study. Eligibility for the current study included weigh in's at baseline, the end of quarter 1 (three months) and the end of quarter 4 (12-months). A flow diagram of the recruitment process is presented in Figure 1.

Figure 1. CONSORT Diagram of Recruitment Process



Measures:

Biological Variables and Demographics: Participants reported demographic information including age, ethnicity, race, and gender. Additionally, participants were asked questions regarding their income, marital status, religion, and education level. Participants were administered a series of measures at baseline and were weighed at baseline, and again at three and 12 months after baseline. Height and weight were measured using standardized procedures and BMI was subsequently calculated by dividing weight in kilograms by height in meters squared. Participants' percent weight change between baseline, three months, and 12 months (the conclusion of the 12-month behavioral weight loss intervention) was calculated by finding the participant's percentage of weight loss from baseline to their weight at three months and percentage of weight loss from three months to 12 months.

Participants completed surveys of demographic information, nutritional status, and weight loss behaviors. This included a Questionnaire on Eating and Weight Patterns (Spitzer et al., 1992). The α estimate for this scale was .79. As a measure of age of first diet attempt, participants were asked to report the age at which they first attempted weight loss (i.e., less than 12 years old, 13-19 years old, 20-29 years old, 30-39 years old, greater than 40 years old). As a measure of disordered eating, participants were also asked, during the past three months did you (1) ever take more than the recommended dose of laxatives in order to avoid gaining weight (2) ever take more than the recommended dose of diuretics (water pills) in order to avoid gaining weight (3) you ever fast – for example, not eat anything at all for at least 24 hours -- in order to avoid gaining weight (4) ever exercise excessively –for example, exercised even though it interfered with important activities or despite being injured –specifically in order to avoid gaining weight (5) ever take more than the recommended dose of a diet pill in order to avoid gaining weight (6) you ever make

yourself vomit in order to avoid gaining weight. The participants answered yes or no to each of the aforementioned questions. Scores ranged from 0 to 1, with a score of 1 indicating participants answered yes to at least one of the 6 disordered eating behaviors. If participants answered no to all 6, they were given a score of 0. Of note, the disordered eating variable looked at disordered eating generally, and did not assess for binge eating disorder.

Procedure: The current study is a secondary analysis of clinical trial data to examine the relationship between participant's self-reported age of first diet attempt, self-reported use of unhealthy disordered eating behaviors, and the relationship of those two variables on weight lost throughout a behavioral weight loss intervention. Participant's self-reported age of first diet attempt was defined as dieting before the age of 12 or prior to puberty, dieting during participants' pubertal years (i.e., 13-19 years old), or dieting after puberty in increments of 10 years (i.e., 20-29 years, 30-39 years, >40 years old). Participants' self-reported age of first diet attempt was assessed for in this nature to examine potential effects that initiating dieting before puberty, during puberty, after puberty, or into adulthood could have on both the development of disordered eating behaviors and the effects of weight control success throughout a behavioral weight loss intervention. Rubinstein et al. (2010) examined dieting age before and after age 12. Age of first dieting attempt was chosen to be examined in this manner to gain insight into the effects of initiating dieting before puberty, during puberty, after puberty, and into adulthood have on both the development of disordered eating behaviors and its possible relation to differential trends in weight loss throughout a behavioral weight loss intervention.

Previous research suggests there may be differences in weight loss due to physiological and psychological factors that are associated with dieting from younger ages (Marginean et al., 2018; Neumark-Sztainer et al., 2007). Additionally, past research has noted that dieting in

childhood and adolescence is related to the development of short term and likely disordered eating behaviors which were also assessed for and include vomiting, laxative, diuretic, diet pill, fasting, and exercising excessively (Neumark-Sztainer et al., 2007; Spitzer et al., 1992).

Given the past research on participants' weight loss within behavioral weight loss interventions and the gap in the literature pertaining to participants' who do not follow typical weight loss trajectories, the first aim of this proposal sought to examine the relationship between the self-reported age of first diet attempt and the use of disordered eating behaviors on weight lost throughout a behavioral weight loss intervention. Within the first aim, the age of first dieting attempt and the self-reported use of disordered eating behaviors were considered as independent variables. The weight lost at three months and 12 months were considered as dependent variables. The weight loss was calculated by figuring out the participant's percentage of weight loss from baseline to their weight at three months and percentage of weight loss from three months to 12 months.

Within the second aim, the age of first diet attempt (i.e., less than 12 years old, 13-19 years old, 20-29 years old, 30-39 years old, greater than 40 years old) was considered the independent variable. The presence of disordered eating behaviors reported was categorized into yes or no. If a participant reported any disordered eating behavior including vomiting, laxative, diuretic, diet pill, fasting, exercising excessively they received a score of 1. If someone did not report disordered eating they received a score of 0. The presence of disordered eating behaviors was considered the dependent variable.

Data Analysis

Preliminary Analyses:

A series of preliminary analyses was conducted to determine if the data met a set of assumptions that underlie the Mixed-Design ANCOVA. The following assumptions were addressed: (1) statistical outliers within each cell using box-plots. If a subject was determined to be an extreme statistical outlier (i.e., greater than 3 box lengths) they were removed from the analysis. (2) Normality of weight loss within each of the cells using the Wilk-Shapiro Test of Normality. If violations of normality were found, it was determined if transformations of the data were required. Given the larger number of subjects, the Mixed-Design ANCOVA was robust to violations in normality. (3) Homogeneity of variance for each level of the between factor using the Levene's Test for Equality of Variances. If there was heterogeneity of variance, data transformations will were used in an attempt to address this assumption violation. (4) Homogeneity of covariance using Box's Test of Equality of Covariance Matrices. If there was heterogeneity, the change in weight loss from three months to 12 months was analyzed separately for each level of the between-subject variables (i.e., age of first diet attempt, level of disordered eating behavior) (Field, 2018; Leard, 2020).

In order to assess if the data met the monotonic assumptions of a Spearman Rho Correlation, a scatterplot was generated showing the two variables in the analysis. If the monotonic assumption was violated, the data was transformed (Field, 2018; Leard, 2020).

Statistical Analyses

Aim 1: To determine if age of first dieting attempt and disordered eating behaviors are related to short- and long- term weight control success within a 12-month behavioral weight loss intervention.

Hypothesis 1: There will be a relationship between self-reported age of first dieting attempt and weight lost at three months and 12 months, while controlling for treatment condition. It was hypothesized that participants who self-reported dieting earlier would

1a: lose more weight in the first three months of the intervention than people who initiated dieting later in life.

1b: lose less weight at the end of the intervention than people who initiated dieting later in life.

Statistical Analyses: The analysis of the relationship between participant's self-reported age of first diet attempt and weight lost at three months and 12 months of a 12-month behavioral weight loss intervention was conducted in a two-step manner. First, a Spearman Rho Correlation was calculated to assess the relationship of age of first diet attempt to weight loss at three months and 12 months. A Spearman Rho correlation was chosen due to the ordinal nature of the age of first diet attempt variable. Subsequently, a Mixed-Design ANCOVA was conducted. The ANCOVA determined if there was evidence to conclude that there was a differential trend in percent weight loss from three months to 12 months as a function of age of first diet attempt. The age of self-reported first diet attempt was considered an independent between-subjects variable (i.e., ages <12, 13-19, 20-29, 30-39, >40). The repeated measure dependent variable was calculated from weight loss at three months (i.e., % baseline weight in lbs – % weight loss lbs at three months) and weight loss at 12 months (i.e., % weight loss lbs at three months – weight in lbs at 12 months). Should a significant interaction effect between age of first diet attempt and weight loss at three months and 12 months be found, which would indicate a differential trend in weight loss from three months to 12 months as a function of age of first diet attempt, a set of paired t-tests was used to compare weight loss at three months and 12 months within each of the age of first diet attempt groups.

Hypothesis 2: There will be a relationship between the report of self-reported disordered eating behaviors used and the weight loss at three months and 12 months, while controlling for treatment condition. It was hypothesized that participants who report disordered eating behaviors will

2a: lose more weight in the first three months of the intervention than people who reported no disordered eating behaviors

2b: lose less weight at the end of the intervention than people who reported no disordered eating behaviors.

Statistical Analyses: The analysis of the relationship between participant's self-reported disordered eating behaviors and weight loss at three months and 12 months of a 12-month behavioral weight loss intervention was conducted in a two-step manner. First, a Spearman Correlation was calculated to assess the relationship of the presence of disordered eating behaviors to weight loss at three months and 12 months. A Spearman Rho Correlation was chosen due to the presence of disordered eating behaviors and the weight loss being an ordinal level variable. Subsequently, a Mixed-Design ANCOVA was conducted to determine if there is evidence to conclude that there was a differential trend in weight loss from three months to 12 months as a function of the reported number of disordered eating behaviors, while controlling for treatment condition. The report of disordered eating behaviors is considered an independent between-subjects variable (i.e., 0, none -1, any of behaviors reported: vomiting, laxative, diuretic, diet pill, fasting, exercising excessively). The repeated measure dependent variable is weight loss at three months (i.e., % baseline weight in lbs – % weight loss in lbs at three months) and weight loss at 12 months (i.e., % weight loss in lbs at three months – weight in lbs at 12 months). Should a significant interaction effect between the reported number of disordered eating behaviors and weight loss at three months

and 12 months be found, which would indicate a differential trend in weight loss from three months to 12 months as a function of disordered eating behaviors, a set of paired t-tests was used to compare weight loss from three months and 12 months within each of the number of disordered eating behavior groups.

Aim 2: To determine whether the self-reported age of first diet attempt is related to the number of self-reported use of disordered eating behaviors.

Hypothesis 3: There will be a significant relationship between self-reported age of first diet attempt and the number of disordered eating behaviors, such that the younger a participant reported their first diet attempt, the more likely they will be to report using disordered eating behaviors.

Statistical Analyses: A Chi Square Analysis was used to examine the relationship between self-reported age of first diet attempt (i.e., ages <12, 13-19, 20-29, 30-39, >40) and the self-report of disordered eating behaviors reported (i.e., 0-1 behaviors reported: vomiting, laxative, diuretic, diet pill, fasting, exercising excessively). A Chi Square was chosen due to the ordinal nature of the age of first diet attempt variable.

Power Analysis:

Based on a priori power analysis using G*power 3.1, a total sample size of 115 participants yielded a 95% power to explore whether self-reported age of first diet attempt and the use of disordered eating behaviors are related to greater early weight loss and subsequent poorer weight loss outcomes using a medium effect size (d =.5) (Faul et al., 2007; Fault et al., 2009). Based on a priori power analysis using G*power 3.1, a total sample size of 424 participants yielded a 98%

power to explore whether self-reported age of first diet attempt and the use of disordered eating behaviors are related to greater early weight loss and subsequent poorer weight loss outcomes using a medium effect size (*d* =.5). Thus, this study was adequately powered to detect a medium effect size.

Additionally, based on a priori power analysis using G*power 3.1, a total sample size of 115 participants yielded a 95% power , and a sample size of 424 participants yielded a 98% power, to explore the relationship between self-reported age of first diet attempt and the number of disordered eating behaviors reported at baseline using a medium effect size (*d* =.5) (Faul et al., 2007; Fault et al., 2009).

Given this weight loss intervention has 424 participants, the analyses were adequately powered to detect a medium effect size.

Chapter III: Results

Demographics

The sample of participants who completed the weight loss intervention was made up of 385 females and 81 males (n = 466). The sample mean BMI was 35.7 (SD = 6.5), and the sample mean age was 53.6 (SD = 11.4). The sample of participants were majority white (84%), highly educated, married (68.7%) and Jewish (32.4%). Within the sample, 8.2% of participants started dieting before the age of 12, 35.2% participants initiated dieting between 13 and 19 years old, 24.2% of participants began dieting between 20 and 29 years old, 17% of participants initiated dieting between 30 and 40 years old, and 15.2% of participants initiated dieting after the age of 41 years old.

Table 1. Frequencies and Percentages for Demographic Variables for Participants Who Completed the Behavioral Weight Loss Program

Variable	Sample (n=466) % or Mean (Standard Deviation)
Gender	
Male	17.7%
Female	82.3%
Age	53.6 years (11.4 years)
Body Mass Index (BMI)	35.7kg/m^2 (6.5kg/m^2)
25-29.9 Overweight	19.6%
30-34.9 Class I Obesity	33.9%
35-39.9 Class II Obesity	24.1%
40+ Morbid Obesity	22.4%
Ethnicity	
White	84.0%
African American	9.8%
Hispanic	3.0%
Asian/ Pacific Islander	1.0%
Other	2.3%
Education	
Grade 10-11 (Highschool)	0.6%
High School Degree	16.4%
1+ Year Highschool	24.7%
College Degree	24.9%
Graduate Degree	33.3%
Marital Status	
Single	14.5%
Married	68.7%
Divorced	10.4%
Widowed	6.4%
Religion	
Catholic	26.7%
Jewish	32.4%
Protestant	7.7%
None	2.5%
Other	3.8%
No Response	26.4%
Age of First Diet Attempt	
Before 12	8.2%
13-19	35.2%
20-29	24.2%
30-40	17.0%
After 41	15.2%

The results of the analyses that addressed the hypotheses in this study are presented in two sections. The first section is a description of the procedure used to assess for statistical outliers and how it was determined if a subject should be dropped from the analyses. The second section presents the analyses that tested each of the hypotheses.

Analysis to Detect Statistical Outliers

Frequency distributions were generated for percent of weight lost at three months and from three to 12 months for each of the cells that comprised the main effects (i.e., type of intervention, history of disordered eating, and age of first diet attempt) and interaction effects (i.e., type of intervention by history of disordered behavior, type of intervention by age of first diet attempt). A visual inspection of each of these distributions was conducted to assess if there were any obvious statistical outliers. The descriptive statistics were also generated, and the means and standard deviations were used to assess if any of the data points was greater than three standard deviations from the mean. If a data point was greater than three standard deviations from the mean, it was inspected to assess if there was an error in data entry. If it was determined that there was no entry error, the potential outlier was further inspected to assess if they were extreme in comparison it next closest data point and if the percentage of weight loss or gain would be unreasonable or unlikely. One subject was determined to be a statistical outlier given these criteria. This particular subject gained 31.14% of their baseline weight within the first three months of the study. The next closest subject gained 8.49% of his baseline weight.

As pointed out by Laerd (2013), it is difficult to decide what to do with a potential outlier in the data and that there has been much written on the subject. Laerd's suggestion is to outline the procedures used to determine the presence of an outlier and the reason for removing or keeping it.

Aim 1 Hypothesis 1

The first hypothesis stated that there will be a relationship between self-reported age of first dieting attempt and percent weight loss at three months and at 12 months, while controlling for treatment condition. The percent of weight loss at three months was defined as weight lost between the start of intervention and three months divided by starting weight. Percent weight lost at 12 months was defined as weight lost between three months and 12 months divided by starting weight. It was hypothesized that participants who self-reported dieting earlier will lose more weight in the first three months of the intervention than people who initiated dieting later in life. Furthermore, it was hypothesized that those who initiated dieting earlier in life will lose less weight between three and 12 months than people who initiated dieting later in life.

In order to address this hypothesis a series of statistical analyses were conducted. The first analysis utilized a series of Spearman Rho Correlations to assess if age of first dieting attempt was correlated with percentage of weight lost at three months and between three months and 12 months. This was followed by a Mixed Design Analysis of Variance that assessed if there was a differential trend of percent of weight loss at three months and at 12 months as a function of age of first diet attempt. The type of intervention (i.e., workbook, computer, direct intervention) the subjects received was also included in the analysis since it could have explained significant variance, thereby reducing error. Therefore, there were two between subject variables (type of intervention and age of first diet attempt) and one within subject variable (percentage of weight loss at three

and between three and 12 months). Thus, it was hypothesized that there would be a differential trend of percent weight loss across the different age categories of first diet attempts (i.e. interaction of age of first dieting and percent weight lost at three months and between three months and 12 months).

The first step in conducting the Spearman Rho Correlation was to assess if the data met the underlying assumption that there is a monotonic relationship between the variables under study. Utilizing the scatterplot feature of SPSS, it was determined that the relationship was monotonic in nature. The scatterplot that shows the monotonic relationship is provided in figures 2 and 3.

Figure 2

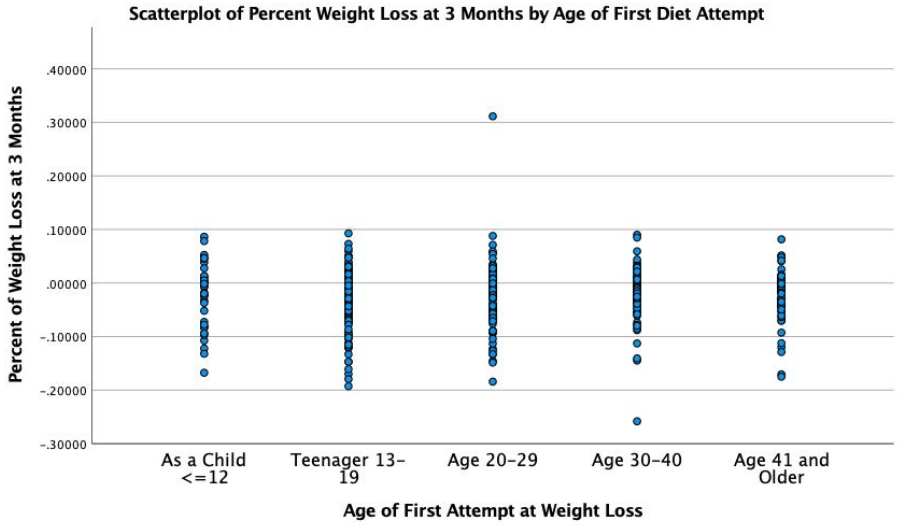
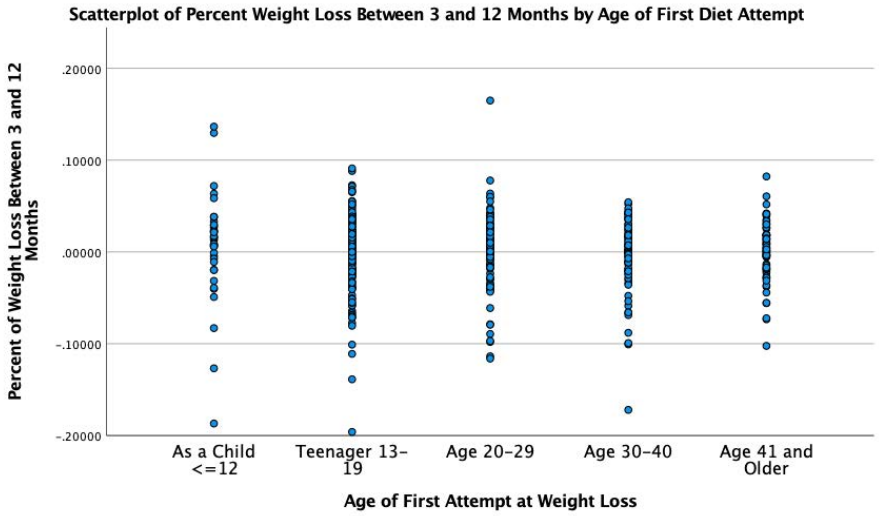


Figure 3



The results of the Spearman Rho Correlation revealed no relationship between age of first diet attempt and percentage of weight loss at three months, $r(421) = .025$, $p = .605$ and the relationship at 12 months, $r(421) = -.037$, $p = .452$.

The first step in conducting the Mixed Design Analysis of Variance was to assess if the data met underlying assumptions of sphericity, no statistical outliers, homogeneity of variance within each of the between subject variables, and normality of the percentage of weight lost.

The sphericity assumption was not of concern since there were only two levels of the within subject variable (i.e., percentage of weight loss between the start of intervention and three months and from three months to 12 months) and the assumption was automatically met. The assumption regarding there being no statistical outliers was addressed above and will not be addressed here. The Levene Test of Homogeneity of Error Variance indicated that there was no evidence to conclude this assumption was violated for percent weight loss at three months, Levene Test = 1.206, $p = .268$ and percent weight loss between three months and 12 months, Levene Test = 1.474, $p = .117$.

Finally, the Shapiro-Wilk statistic was used to assess if the data deviated from normality within each of the cells. There was a total of 30 cells that were tested due to the three levels of type of intervention (i.e., workbook, computer, direct intervention), five levels of age of first attempt (age 12 or less, 13-19, 20-29, 30-40 and over 40) and two measures of percentage of weight lost (three and 12 months). Of these 30 cells, nine of the Shapiro-Wilks statistics were significant, indicating there was evidence that the data within these cells deviated from normality (Table of Shapiro-Wilks Statistics below). These results are presented in table 2. Leard (2013) stated that the Mixed Design Analysis of Variance can proceed given that it is fairly robust to deviations from normality.

Table 2. Shapiro-Wilks Statistics to Test for Cell Normality for Age of First Diet Attempt and Type of Intervention at Three Months and Twelve Months

	3 Months	*df*	*p*	12 Months	*df*	*p*
Intervention						
Age of First Diet Attempt						
Workbook						
Child 12 Years or Less	.923	10	.381	.915	10	.316
Teenage 13-19	.979	31	.786	.965	31	.398
Age 20-29	.959	22	.470	.964	22	.579
Age 30-40	.973	16	.880	.770	16	.001
Age 41 and Older	.928	13	.323	.916	13	.220
Computer						
Child 12 Years or Less	.961	7	.831	.954	7	.765
Teenage 13-19	.940	60	.006	.973	60	.195
Age 20-29	.950	33	.129	.895	33	.004
Age 30-40	.851	28	<.001	.955	28	.269
Age 41 and Older	.890	23	.016	.966	23	.597
Direct Intervention						
Child 12 Years or Less	.970	20	.762	.948	20	.331
Teenage 13-19	.950	58	.019	.887	58	<.001
Age 20-29	.985	44	.842	.937	44	.019
Age 30-40	.974	28	.692	.951	28	.211
Age 41 and Older	.924	30	.035	.988	30	.975

The results of the Mixed Design Analysis of Variance are presented in Table 3. The effect that addressed hypothesis one is the interaction of the age of first diet attempt by percentage of weight at three and between three and 12 months. An inspection of this table reveals that this effect was not significant, $F(4, 408) = .023$, $p = .896$. Therefore, there was no evidence to reject the null hypothesis that the trend of percentage of weight loss across the two time periods differed as a function of the age of first diet attempt. Further inspection of table 3 reveals that there was a within subject main effect of weight loss, $F(1, 408) = 31.47$, $p < .001$. Further inspection of this main effect shows that there was a greater percent of weight loss between the start of intervention and three months, (M = -2.46, SD = 5.39) when compared to percent weight loss between three and 12 months, (M = .019, SD = 4.18). There was also a between subject main effect of type of intervention, $F(2, 408) = 3.64$, $p = .027$. Further analysis utilizing the Bonferroni procedure revealed that the direct intervention condition lost a greater amount of weight overall (M = -3.29, SD = 7.01) when compared to the workbook condition (M = -1.01, SD = 5.82), Bonferroni $p = .021$.

Table 3. Mixed Design Analysis of Variance for Age of First Diet Attempt, Type of Intervention and Percent of Weight Loss at Three months and from Three Months to 12 Months.

Source	Between Sum of Squares	*df*	Mean Square	*F*	*p*
Within Subject Effects					
Percent Weight Loss at three and 12 months (Weight Loss)	.071	1	.071	31.47	<.001
Weight Loss by Type of Intervention Interaction	.023	2	.011	5.07	.007
Weight Loss by Age of First Diet Attempt	.002	4	.001	.272	.896
Weight Loss by Type of Intervention Interaction by Age of First Diet Attempt Interaction	.018	8	.002	1.01	.426
Error	.915	408			
Between Subject Effects					
Type of Intervention	.015	2	.008	3.74	.027
Age of First Diet Attempt	.004	4	.001	.47	.758
Type of Intervention by Age of First Diet Attempt	.022	8	.003	1.28	.254
Error	.862	408			

Further inspection of table 3 reveals that there was a significant interaction between type of intervention and the percentage of weight lost at three months and between three months and 12 months, $F(2, 408) = 5.07$, $p = .007$. Therefore, an analysis of the simple main effects needed to take place since there was a differential trend in percent of weight at three months and between three and 12 months within each of the intervention groups. Within the workbook condition, there were no differences in percent of weight lost, $F(1, 91) = 3.14$, $p = .08$, indicating no mean differences at three months (M = -1.09, SD = 3.71) and from three months to 12 months (M = .040, SD = 4.73). There were differences in the computer condition, $F(1,151) = 17.35$, $p < .001$ with participants in this group evidencing greater percent of weight lost at three months (M = -2.34, SD = 5.69) than from three months to 12 months (M = .035, SD = 4.09). There were also differences within the direct intervention group, $F(1,180) = 38.01$, $p < .001$) with participants evidencing greater percent weight loss at three months (M = -3.26, SD = 5.73) when compared to 12 months (M = .053, SD = 3.98).

Aim 1 Hypothesis 2

The second hypothesis stated that there will be a relationship between self-reported disordered eating behavior and weight loss at 3 months and at 12 months, while controlling treatment condition. Eating disordered behavior was defined as engaging in any history of eating disordered behavior (i.e., vomiting, laxative, diuretic, diet pill, fasting, exercising excessively). It is hypothesized that participants who self-reported disordered eating behavior will lose a greater percent of weight in the first three months of the intervention when compared to people who didn't report eating disorder behavior. Conversely, it was hypothesized that those who reported eating disordered behavior will lose a lesser percentage of their weight between three and 12 months of

intervention when compared to people who did not report eating disordered behavior. In essence, it was hypothesized that there would be a differential trend of percent weight loss between those who reported eating disordered behavior and those who did not.

In order to address this hypothesis a series of statistical analyses were conducted. The first analysis utilized a series of t-tests to assess if eating disordered behavior was related to percentage of weight lost at three months and at 12 months. This was followed by a Mixed Design Analysis of Variance that assessed if there was a differential trend of percent of weight loss at three months and at 12 months as a function of eating disordered behavior. The type of intervention the subjects received was also included in the analysis since it a variable that could have explained significant variance, thereby reducing error. Therefore, there were two between subject variables (type of intervention and eating disordered behavior) and one within subject variable (percentage of weight loss at three months and from three months to 12 months). If significant interactions were found, an analysis of simple main effects was conducted to better understand the nature of the interaction.

The results of the t-tests revealed no relationship between eating disordered behavior and percentage of weight loss at three months, $t(422) = -1.82$, $p = .07$ and between three and 12 months, $t(422) = -1.47$, $p = .141$.

As indicated above, the first step in conducting the Mixed Design Analysis of Variance was to assess if the data met underlying assumptions of sphericity, no statistical outliers, homogeneity of variance within each of the between subject variables, and normality of the percentage of weight lost.

The sphericity assumption was not of concern since there were only two levels of the within subject variable (i.e., percentage of weight loss between the start of intervention and three months and from three months to 12 months) and the assumption was automatically met. The assumption

regarding there being no statistical outliers was addressed above and is not addressed here. The Levene Test of Homogeneity of Error Variance indicated that there was no evidence to conclude this assumption was violated, Levene Statistic = 1.891, p = .095 for percent weight loss at three months and Levene Statistic = .336, p = .891 for percent weight loss between three and 12 months.

Finally, the Shapiro-Wilk statistic was used to assess if the data deviated from normality within each of the cells. There was a total of 12 cells that were tested due to the three levels of type of intervention, two levels of eating disordered behavior (reported history or no reported history of eating disordered behavior) and two measures of percentage of weight lost (three and 12 months). Of these 12 cells, six of the Shapiro-Wilks statistics were significant, indicating there was evidence that the data within these cells deviated from normality (Table of Shapiro-Wilks Statistics below). These results are presented in Table 4. As determined above, the Mixed Design Analysis of Variance can proceed given that it is fairly robust to deviations from normality (Laerd, 2013).

Table 4. Shapiro-Wilks Statistics to Test for Cell Normality for Disordered Eating Behavior and Type of Intervention at Three Months and Twelve Months

	3 Months	*df*	*p*	12 Months	*df*	*p*
Intervention						
Disordered Eating Group						
Workbook						
Low Disordered Eating Group	.985	50	.778	.797	50	<.001
High Disordered Eating Group	.975	42	.465	.969	42	.294
Computer						
Low Disordered Eating Group	.914	89	<.001	.930	89	<.001
High Disordered Eating Group	.964	62	.063	.970	62	.138
Direct Intervention						
Low Disordered Eating Group	.973	105	.033	.969	105	.016
High Disordered Eating Group	.975	75	.153	.900	75	<.001

The results of the Mixed Design Analysis of Variance are presented in Table 5. The effect that addressed second part of hypothesis one is the interaction of disordered eating behavior by percentage of weight loss three months and from three months to 12 months. The effect assessed if there was a differential trend in percent of weight loss across the two time measurement periods. An inspection of this table reveals that this effect was not significant, $F(1, 417) = .046$, $p = .831$). Therefore, there was no evidence to reject the null hypothesis that the trend of percentage of weight loss across the two time periods differed as a function of eating disordered behavior. The main effects of type of intervention, percent of weight lost at three months and at 12 months, and the interaction of type of intervention and percent of weight lost at three months and at 12 months, were not discussed here given they were discussed above.

Table 5. Mixed Design Analysis of Variance for History of Eating Disordered Behavior, Type of Intervention and Percent of Weight Loss at Three months and from Three Months to 12 Months.

Source	Between Sum of Squares	*df*	Mean Square	*F*	*p*
Within Subject Effects					
Percent Weight Loss at three and 12 months (Weight Loss)	.101	1	.101	45.02	<.001
Weight Loss by Eating Disorder Behavior	.000	2	.000	.046	.831
Weight Loss by Type of Intervention Interaction	.019	1	.009	4.17	.016
Weight Loss by Type of Intervention Interaction by Eating Disorder Behavior Interaction	.003	2	.002	.761	.468
Error	.933	417	.002		
Between Subject Effects					
Eating Disorder Behavior	.007	1	.091	3.45	.064
Type of Intervention	.017	2	.007	4.00	.019
Type of Intervention by Eating Disorder Behavior	.005	2	.008	1.23	.292
Error	.871	417	.003		

Hypothesis 3

The third hypothesis stated that there would be a relationship between self-reported age of first diet attempt and eating disordered behavior. A chi-square analysis was used to address this hypothesis. The results of the chi-square analysis revealed a significant relationship, $X^2(4) = 34.13$, $p < .001$. A review of table 6 revealed that individuals who were age 41 and older when they made their first diet attempt had a higher percent (83.1%) in the no history of eating disordered behavior when compared to the other age groups. In addition, individuals who were age 12 and younger when they made their first diet attempt had a higher percent (68.4%) in the group that reported a history of eating disorder behavior than the other age groups.

Table 6. Crosstabs of Age of First Diet Attempt by History of Eating Disordered Behavior

	Age Group	12 or less	13-19	20-29	30-40	41 and older
Group						
No History of Eating Disordered Behavior		12 31.6%	80 48.8%	65 57.5%	46 58.2%	59 83.1%
History of Eating Disordered Behavior		26 68.4%	84 51.2%	48 42.5%	33 41.8%	12 16.9%

Note: X^2 (4) = 34.13, p <.001

Summary of Results

The analyses that addressed hypotheses one and two revealed that there was no evidence that there was a differential trend of percent weight loss at three months and between three and 12 months as a function of age of first diet attempt and eating disordered behavior. There was a differential trend in percent weight loss as a function of the type of intervention the subjects received. The analysis of simple main effects revealed differences in percent weight loss at three months and 12 months within the computer and direct intervention groups, with greater weight loss at three months than between three months and 12 months in both groups. There were no differences in the workbook condition. The analyses also revealed greater percent of weight loss at three months when compared to between three and 12 months. In addition, the intervention group had a greater percent of weight loss when compared to the workbook condition.

The analysis that addressed the third hypothesis revealed a relationship between age of first diet attempt and eating disordered behavior. Those subjects who made their first diet attempt at age 40 or older were less likely to have engaged in eating disordered behavior when compared to the other age groups while those who first attempted dieting at age 12 or younger were more likely to have engaged in eating disorder behavior when compared to the other age groups.

Chapter IV: Discussion

The current study analyzed pre- and post- intervention data from 424 participants enrolled in a 12-month behavioral weight loss intervention. Aim 1 sought to determine if the age of participants first dieting attempt and disordered eating behaviors were related to short- and long-term weight control success within a 12-month behavioral weight loss intervention, while controlling for intervention type. It was hypothesized that there would be a significant relationship between self-reported age of first dieting attempt and weight lost at three months and 12 months, while controlling for treatment condition. It was also hypothesized that participants who self-reported dieting earlier would lose more weight in the first three months of the intervention than people who initiated dieting later in life and that participants who self-reported dieting earlier would lose less weight at the end of the intervention than people who initiated dieting later in life. Furthermore, it was hypothesized that there would be a significant relationship between the report of self-reported disordered eating behaviors used and the weight loss at three months and 12 months, while controlling for treatment condition. Finally, it was hypothesized that participants who reported disordered eating behaviors would lose more weight in the first three months of the intervention than people who reported no disordered eating behaviors and that participants who reported disordered eating behaviors would lose less weight at the end of the intervention than people who reported no disordered eating behaviors.

The analyses that addressed Aim 1 revealed that there was no evidence that there was a differential trend of percent weight loss at three months and between three and 12 months as a function of age of first diet attempt and eating disordered behavior.

Given the age of first dieting attempt was not related to weight lost at three months and 12 months, it is likely that this variable is not related to whether participants utilize more consistent weight loss behaviors. However, according to past research from this dataset, a history of a greater number of self-reported dieting attempts was associated with less weight loss during the 12-month behavioral weight loss program (Phillipson et al., 2020).

Future research may want to further assess the influence of the age at which participants' make their first dieting attempt and it's relation to the amount of dieting attempts over one's lifetime and consider the biological influence that more dieting attempts would have in weight loss trajectories within behavioral weight loss interventions. The self-reported use of disordered eating behaviors was also not related to weight lost at three months and 12 months. It is possible that participants felt motivated to not use extreme weight loss methods during the intervention. Future research may benefit from the continued assessment throughout weight loss interventions of whether participants use disordered eating behaviors upon starting the intervention. Additionally, this study broke the disordered eating behavior variable into either reporting no use of disordered eating behavior or reporting any. Future research may want to assess if specific disordered eating behaviors may be related to different weight loss trajectories. Additionally, it may be important to differentiate a participant who reports the use of one disordered eating behavior compared to a participant who is reporting five or six behaviors. Future research may also want to continue to identify other factors related to less consistent weight loss behaviors.

There was a differential trend in percent weight loss as a function of the type of intervention the subjects received. The study found that a significant interaction existed between type of intervention and the percentage of weight lost at three months and between three and 12 months. Within the workbook condition, there were no differences in the percent weight lost at three

months and three to 12 months. Participants in the workbook condition lost 1.09 percent of their body weight between baseline and three months contrasted with participants gaining .04 percent of their body weight between three months and 12 months. This difference was not significant. However, significant differences in the percent weight loss at three months and three to 12 months were present in the computer condition and the intervention condition. Within the computer condition, participants lost a mean of 2.34 percent of their body weight between the initiation of the intervention and three months. This was contrasted with participants in the computer condition gaining .035 percent of their body weight between three and 12 months. Additionally, participants in the intervention group lost significantly more weight between the start of the intervention and three months than they did between three and twelve months. Specifically, participants in the intervention condition lost 3.26 percent of their body weight between the start and three months compared to gaining .053 percent of their weight between three and 12 months. These results are in line with previous research that note the difficulty of long-term weight loss and the propensity for participants to gain weight back in the long term (Fothergrill et al., 2016). These results also point to the importance of continuing to research and understand the behavioral and physiological underpinnings of weight loss recidivism to help support individuals with overweight and obesity in achieving and maintain weight loss.

The transtheoretical model of behavior change and theories of motivation may be potential explanations for the significant difference between percent weight lost at start to three months and three months to 12 months. The transtheoretical model of change is a theory to explain human behavior change. It is broken into 5 stages including the pre-contemplation stage, the contemplation stage, the preparation stage, the action stage, and the maintenance stage (Pinheiro de Freitas et al., 2020). Within the pre-contemplation stage are individuals who do not intend to

change their behavior in the foreseeable future. The contemplation stage includes individuals that recognize the need for change but future action is required to shape their motivation. Within the preparation stage are individuals that are ready to change their behavior within the following 30 days. Within the action stage are individuals that are capable of short and immediate changes for a period of up to six months. Finally, within the maintenance stage are individuals whose behavior has been changed over six months. This stage requires the prevention of relapse and consolidation of gains. (Pinheiro de Freitas et al., 2020)

Studies have shown that the transtheoretical model of change can help guide intervention methodology to promote long lasting weight loss behaviors. High levels of readiness to change are considered critical to the long-term success of weight management (Wadden et al., 2005). Pinheiro de Freitas et al. (2020) evaluated the effect of intervention performed according to the transtheoretical model of change in a primary care setting over 6 months. The intervention groups received personally tailored interventions depending on which stage of change they were in, and the intervention groups showed significantly more improvement with weight loss at the end of the 6 month weight loss intervention. The intervention group also showed significant improvement in terms of BMI and blood glucose results comparative to the non-intervention group (Pinheiro de Freitas et al., 2020).

Future research on the efficacy of behavioral weight loss interventions may consider assessing readiness for change before the intervention begins and again at three months. Participants in this study's behavioral weight loss intervention seem to be mostly in the action phase at three months, considering they lost a significant percentage of their body weight in those three months. Due to the decline in percent of weight lost between three and twelve months it may

be important to use motivational interviewing techniques at this critical point, in order to help participants maintain action and progress to the maintenance phase.

According to Armstrong et al. (2011) motivational interviewing is a directive, patient-centered counselling approach focused on exploring and resolving ambivalence. Motivational interviewing emerged as an effective addiction treatment, yet seems to be efficacious in a weight loss population as well. In Armstrong et al.'s (2011) meta-analysis of motivational interviewing for weight loss randomized control trials, they found significant benefits within weight loss interventions such as significant reductions in body weight and body mass index. Additionally, Barnes & Ivezaj (2015) performed a systematic review of motivational interviewing for weight loss among adults in primary care settings. Their comprehensive literature review of 24 adult randomized controlled trials found that motivational interviewing techniques were associated with significant weight loss as post-treatment assessment compared to control groups and that participants in the motivational interviewing conditions were able to achieve at least 5% loss of initial body weight (Barnes & Ivezaj, 2015). Mirkarimi et al. (2017) found that motivational interviewing was effective in increasing the efficacy and continuity of weight loss.

The results from this study indicate that the three-month point of a behavioral weight loss intervention might be a critical moment in participants weight loss trajectory to intervene regardless of whether the intervention is delivered over a computer or in person. Given the results, participants lost a clinically significant amount of weight during the first three months of the intervention, allowing associated cardiovascular health benefits associated with weight loss to occur (Jensen et al., 2013; Lemstra et al., 2016). Future research may want to consider implementing psychoeducation on the positive influence of losing 2-3 percent of one's body weight, in addition to using motivational interviewing techniques around the three-month mark,

and exploring if this is a technique that allows participants to continue to lose a significant percent of their weight. The results from this study also indicate that the three-month point of a behavioral weight loss intervention may be an important timepoint to re-assess whether participants are remaining in the action phase and heading towards the maintenance phase within the transtheoretical model, or whether participants seem to be slipping back into some old habits and moving back towards the contemplation or preparation phase. Future studies could implement qualitative measures to asses for readiness for change.

Aim 2 of this study sought to determine whether the self-reported age of first diet attempt was related to the number of self-reported use of disordered eating behaviors. It was hypothesized that there would be a significant negative correlation between self-reported age of first diet attempt and the number of disordered eating behaviors, such that the younger a participant reported their first diet attempt, the more disordered eating behaviors they will report using. The analysis that addressed the second Aim revealed a relationship between age of first diet attempt and eating disordered behavior. Those subjects who made their first diet attempt at age 40 or older were less likely to have engaged in eating disordered behavior when compared to the other age groups while those who first attempted dieting at age 12 or younger were more likely to have engaged in eating disorder behavior when compared to the other age groups. For example, 68.4% of the participants who began dieting at the age of 12 or less also reported a history of eating disordered behaviors compared to only 16.9% of the participants who started dieting at the age of 41 and older. Of the participants who began dieting after the age of 40, 83.1% of them reported no history of eating disordered behavior.

This finding is in line with past research. Rubinstein et al. (2010) examined whether participants' history of attempting weight loss before the age of 12 was associated with the

development of binge eating disorder. Rubenstein et al. (2010) found that weight loss attempts in childhood may be a risk factor for the development of binge eating disorder in adults. Furthermore, Bornioli et al. (2019) explored the relationship of adolescent body dissatisfaction and disordered eating behaviors. This study found that body dissatisfaction in adolescence can lead to the development of numerous risky behaviors, including the development of disordered eating behaviors, as well as smoking, drug use, self-harm, and high-risk drinking (Bornioli et al., 2019). Bornioli et al. (2019) suggests that body dissatisfaction in adolescence should be considered a public health concern due to the long-term adverse effects of engaging in risky health behaviors. Thus, early interventions to promote body satisfaction may reduce the prevalence of later risky health behaviors among at risk populations (Bornioli et al., 2019).

The findings from Aim 2 add to the body of evidence to suggest that early dieting attempts are associated with an increased risk of disordered eating behavior development (Bornioli et al., 2019; Jebeile et al., 2019; Rubinstein et al., 2010). The findings from Aim 2 also point to the importance of the need for thoughtful approaches from caretakers and pediatricians in addressing childhood and adolescent obesity and weight loss given the known increase risk of the later development of disordered eating behaviors and eating disorders. One study noted that from 2006, pediatricians have made significant increases in their attempts to combat childhood and adolescent obesity and report more frequent conversations about weight loss (Belay et al., 2017). An integrated approach is important in considering the known risks of earlier dieting attempts and the relation to the development of disordered eating behaviors. Jebeile et al. (2019) explored eating disorder development risk within the treatment of obesity for children and adolescents. Their research notes that structured and professionally run obesity treatment interventions for children and adolescents result in fewer reported disordered eating related symptoms including bulimic

symptoms, binge eating, emotional eating, drive for thinness, and eating concern (Jebeile et al., 2019). Thus, there seems to be greater risk for children and adolescents who diet independently, without professional supervision with informed providers.

Golden et al. (2013) note that the focus of weight loss efforts for children and adolescents should be on a healthy lifestyle rather than on weight and given the correct intervention for obesity prevention and treatment, it is possible to reduce the risk of the development of eating disordered behavior later in life. Specifically, Golden et al. (2013) note the importance of discouraging dieting, promoting positive body image, increasing the frequency of family meals, and carefully monitoring weight loss in children and adolescents. There has been a more recent push for patient centered care and implementing ideas from the Health at Every Size Movement in pediatricians care of children and adolescents with obesity. For example, Cardel (2022) noted the importance that all conversations on obesity and weight stigma should use person-first, compassionate, and nonstigmatizing language in order to reduce the risk of weight loss attempts increasing the risk for the development of eating disordered behaviors.

In line with past findings from this study the intervention group had a significantly greater percent of weight loss when compared to the workbook condition (Wylie-Rosett et al., 2001). For example, the intervention condition lost 3.29 percent of their body weight compared to the workbook condition, which lost 1.01 percent of their body weight at the end of the intervention.

Future research may benefit from looking at effect of COVID on weight loss results given the overall better success of more involved interventions and the prevention and lesser availability of in-person interventions due to the pandemic. Caldwell et al. (2022) noted the increase in prevalence of higher obesity and more weight gain during COVID. In their study, Caldwell et al. (2022) examined specific challenges faced by individuals with overweight or obesity who were

actively participating in behavioral weight loss studies. They found that increased levels of stress and anxiety affected participants' ability and desire to adhere to the program (Caldwell et al., 2022).

Since the late 1990's when this behavioral weight loss intervention was conducted, there have been vast improvements in technology. Ufholz & Bhargava (2021) conducted a review of telemedicine interventions for weight loss. They found that although the COVID-19 pandemic was damaging for weight loss efforts, telemedicine interventions could successfully help patients with obesity lose weight. Telemedicine services with videoconferencing features were found to be especially useful in increasing the efficacy of telemedicine weight loss efforts (Ufholz & Bhargava, 2021). With the increase in technology has come mobile apps that allow for coaching features, including the app Noom. Results from a study looking at the efficacy of Noom suggested that clinically important weight loss outcomes were related to the number of articles read, meals logged, steps recorded, messages to participants coach, exercise logged, weigh-ins, and days with 1 meal logged per week (Carey et al., 2021). While this research points to more involved interventions producing greater weight loss outcomes, future research may want to examine differences in efficacy between in person interventions and newer technological advances with intensive mobile app interventions for weight loss.

Limitations

This study has limitations. For example, the data was collected in 1998. Despite the gap in time, the data can still provide useful insights and guide future weight loss research. The measures that were administered at baseline (Questionnaire on Eating and Weight Patterns) have been validated and are still used in research today. Furthermore, the behavioral weight loss intervention

included a dual focus on both diet and exercise, and last 12-months, following the current *Obesity Guidelines* for optimal behavioral weight loss intervention procedures. These data are still being used to examine different aspects related to success within behavioral weight loss interventions and weight control. Therefore, the current study provides valuable and relevant data despite the time that has passed. The data collected at baseline was largely self-reported, which may have been influenced by the $100 dollar deposit and could have led people to under-report eating disorder symptoms or other behaviors related to their weight. Participants from this study were largely white (84%) and over half of the participants acquired a college or graduate degree (58.2%) limiting the generalizability of the data to more diverse populations. Additionally, this study's proposed analyses did not differentiate results between gender or incorporate participants' current age within the analyses. This sample was representative in terms of gender and age of most behavioral weight loss interventions (Wilfey et al., 2018). An additional possible limitation of the study is that the proposed analyses looked only at data for participants who had completed the year-long behavioral weight loss intervention. Other studies have found differences between completers and non-completers during weight loss interventions. However, statistics were run at baseline that suggest there were no differences between characteristics of completers and non-completers, Lastly, the study did not collect data after the conclusion of the 12-month intervention. Thus, there is no data on who maintained their weight loss past the 12-months.

Conclusion

In summary, the age of first diet attempt and the use of disordered eating behaviors were not significantly related to weight loss at three months and between three and 12 months. However, participants lost more weight in the first three months of the intervention than they did between 3

and 12 months. In line with past findings, this paper points to the difficulty people have in maintaining long term weight loss. Using the transtheoretical model of change and motivational interviewing techniques around the 3-month mark may lead to improvements in continued weight loss. Also, in line with past findings, participants within the computer and intervention conditions lost significantly more weight between baseline and three months than three months to 12 months. The more intensive interventions were more efficacious for weight loss results. Participants who started dieting younger in life was related to participants using disordered eating behaviors. In terms of clinical practice, this paper adds to the existing body of literature that points to the importance of care when addressing childhood obesity and weight loss due to the known adverse health effects from the development of disordered eating.

REFERENCES

Almirall, D., Nahum-Shani, I., Sherwood, N.E., & Murphy, S.A. (2014). Introduction to SMART designs for the development of adaptive interventions: with application to weight loss research. *Translational Behavioral Medicine* 4(3):260—74,

Anastasiou, C.A., Karfopoulou, E., & Yannakoulia, M. (2015). Weight regaining: from statistics and behaviors to physiology and metabolism. *Metab Clin Exp*, 64:1395–407.

Appel L.J., Champagne C.M., Harsha D.W., Cooper L.S., Obarzanek E., Elmer P.J., Stevens V.J., Vollmer W.M., Lin P.H., Svetkey L.P., Stedman S.W., Young D.R., (2003). Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. *Writing Group of the PREMIER Collaborative Research Group. JAMA.* Apr 23-30; 289(16):2083-93.

Armstrong, M. J., Mottershead, T. A., Ronksley, P. E., Sigal, R. J., Campbell, T. S., & Hemmelgarn, B. R. (2011). Motivational interviewing to improve weight loss in overweight and/or obese patients: a systematic review and meta-analysis of randomized controlled trials. *Obesity Reviews*, *12*(9), 709-723.

Bandura, A. (2004). Health promotion by social cognitive means. *Health Education & Behavior,* 31, 143-164.

Barnes, R. D., Ivezaj, V., Martino, S., Pittman, B. P., Paris, M., & Grilo, C. M. (2021). 12 Months later: Motivational interviewing plus nutrition psychoeducation for weight loss in

primary care. *Eating and Weight Disorders-Studies on Anorexia, Bulimia and Obesity*, *26*(6), 2077-2081.

Belay, B., Frintner, M. P., Liebhart, J. L., Lindros, J., Harrison, M., Sisk, B., ... & Cook, S. R. (2019). US pediatrician practices and attitudes concerning childhood obesity: 2006 and 2017. *The Journal of Pediatrics*, *211*, 78-84.

Benson. L., Zhang, F., Espel-Huyhn, H., Wilkinson, L., Lowe, M.R. (2020). Weight variability during self-monitored weight loss predicts future weight loss outcome. I*nternational Journal of Obesity*, 44: *1360*-1367.

Bornioli, A., Lewis-Smith, H., Smith, A., Slater, A., & Bray, I. Adolescent body dissatisfaction and disordered eating: Predictors of later risky health behaviors. (2019). *Social Science and Medicine,* 238: 112458.

Bornioli, A., Lewis-Smith, H., Smith, A., Slater, A., & Bray, I. Adolescent body dissatisfaction and disordered eating: Predictors of later risky health behaviors. (2019). *Social Science and Medicine,* 238: 112458.

Butryn, M. L., Webb, V., & Wadden, T. A. (2011). Behavioral treatment of obesity. *Psychiatric Clinics of North America, 34,* 841–859. http:// dx.doi.org/10.1016/j.psc.2011.08.006

Caldwell, A. E., Thomas, E. A., Rynders, C., Holliman, B. D., Perreira, C., Ostendorf, D. M., & Catenacci, V. A. (2022). Improving lifestyle obesity treatment during the COVID-19 pandemic and beyond: New challenges for weight management. *Obesity science & practice*, *8*(1), 32-44

Cardel, M. I., Newsome, F. A., Pearl, R. L., Ross, K. M., Dillard, J. R., Miller, D. R., ... & Balantekin, K. N. (2022). Patient-Centered Care for Obesity: How Health Care Providers Can Treat Obesity While Actively Addressing Weight Stigma and Eating Disorder Risk. *Journal of the Academy of Nutrition and Dietetics*, *122*(6), 1089-1098.

Carey, A., Yang, Q., DeLuca, L., Toro-Ramos, T., Kim, Y., & Michaelides, A. (2021). The Relationship Between Weight Loss Outcomes and Engagement in a Mobile Behavioral Change Intervention: Retrospective Analysis. *JMIR mHealth and uHealth*, *9*(11), e30622.

Chang, J. & Brethauer, S. (2016). Medical Devices in the Treatment of Obesity. *Endocrinol Metab Clin North Am*. 45, 657-665.

Dulloo, A.G. & Montani, J.P. (2015). Pathways from dieting to weight regain, to obesity and to the metabolic syndrome: an overview. *Obesity Reviews*, 16(1) 1-6.

Elran-Barak, R. & Segel-Karpas, D. (2020). Dieting for weight-control among older adults: The role of perceived health and perceived overweight status, *Eating Behaviors.*

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*, 1149-1160.

Feig, E.H. & Lowe, M.R. (2017) Variability in Weight Change Early in Behavioral Weight Loss Treatment: Theoretical and Clinical Implications. *Obesity,* 25(9)1509-1515.

Field, A. P. (2018). *Discovering statistics using IBM SPSS Statistics :*Los Angeles [i.e. Thousand Oaks, Calif.: SAGE Publications.

Field A.E., Aneja P., Austin S.B., Shrier L.A., de M.C., Gordon-Larsen P. (2007). Race and gender differences in the association of dieting and gains in BMI among young adults. *Obesity*, 15: 456–464.

Flegal, K.M., Carroll, M.D., Kit, B.K. &, Ogden, C.L. (2012). Prevalence of obesity and trends in the distribution of body mass index among US adults, 1999-2010. *JAMA*. 307(5):491-7

Fothergrill E., Guo, J., Howard, L., Kerns, J.C., Knuth, N.D., Brychta, R., Chen, K. Y., Skarulis, M. C., Walter, M., Walter, P. J., & Hall, K. D. (2016). Persistent metabolic adaptation 6 years after "The Biggest Loser" Competition. *Obesity, 24,* 1612-1619.doi:10.1002/oby.21538

Golden, N. H., Schneider, M., Wood, C., Daniels, S., Abrams, S., Corkins, M., ... & Slusser, W. (2016). Preventing obesity and eating disorders in adolescents. *Pediatrics*, *138*(3).

Hales, C.M., Carroll, M.D., Fryar C.D., & Ogden C.L. (2018). Prevalence of obesity and severe obesity among adults: United States, *NCHS Data Brief, 2020,* 360, 1-8.

Hamarashid, S.H. (2020). Health Risks Linked to Overweight and Obesity. *Research Journal of Science,* 1(2), 45-53.

Hebden, L., Cook, A., van der Ploeg, H.P., & Allman-Fairnelli, M. (2012).Development of smartphone applications for nutrition and physical activity behavior change. *JMIR,* 1(2), 1-9.

Holtrup, B., Church, C.D., Berry, R., Colman, L., Jeffery, E., Bober, J., & Rodenheffer, M.S. (2017). Puberty in an important developmental period for the establishment of adipose tissue mass and metabolic homeostasis. Adipocyte, 6(3): 224-233.

Jebeile, H., Gow, M. L., Baur, L. A., Garnett, S. P., Paxton, S. J., & Lister, N. B. (2019). Treatment of obesity, with a dietary component, and eating disorder risk in children and adolescents: A systematic review with meta-analysis. *Obesity Reviews*, *20*(9), 1287-1298.

Kroke, A., Liese, A.D., Schulz, M., Bergmann, M.M., Klipstein-Grobusch, K., & Hoffmann, K. (2002). Recent weight changes and weight cycling as predictors of subsequent two-year weight change in a middle- aged cohort. Int J Obes 26: 403–409.

Laerd Statistics (2020). Friedman Test in SPSS. https://statistics.laerd.com/spss-tutorials/friedman-test-using-spss-statistics.php

Lemstra, M., Bird, Y., Nwanko, C., Rogers, M., & Moraros, J. (2016). Weight loss intervention adherence and factors promoting adherence: A meta-analysis. *Patient Preference and Adherence,* 10, 1547-1559.

Liechty, J.M. & Lee, M.J. (2013). Longitudinal Predictors of Dieting and Disordered Eating Among Young Adults in the US. International Journal of ED, 46: 790-800.

Linde, J. A., Jeffery, R.W., Sherwood, N. E., Utter, J., Pronk, N. P., & Boyle, R.G. (2004). Binge Eating Disorder, Weight Control Self-Efficacy, and Depression in Overweight Men and Women. *International Journal of Obesity, 28,* 418-425. doi:10.1038/sj.ijo.0802570

Ma, R., Mikhail, M.E., Fowler, N., Culbert, K.M., & Klump, K.L. (2019). The Role of Puberty and Ovarian Hormones in the Genetic Diathesis of Eating Disorders in Females. Child Adol. Psych Clin. N. Am. 28: 617-628.

MacLean, P. S., Higgins, J. A., Giles, E. D., Sherk, V. D., & Jackman M. R. (2015). The role for adipose tissue in weight regain after weight loss. *Obesity 16*, 45-54. doi: 10.1111/obr.12255

Marginean, C.O., Marginean, C., Melit, L.E. (2018). New Insights Regarding Genetic Aspects of Childhood obesity: A minireview. *Frontier in Pediatrics*, 6: 1-8.

Mirkarimi, K., Kabir, M. J., Honarvar, M. R., Ozouni-Davaji, R. B., & Eri, M. (2017). Effect of motivational interviewing on weight efficacy lifestyle among women with overweight and obesity: a randomized controlled trial. *Iranian Journal of Medical Sciences*, *42*(2), 187.

National Heart, Lung, and Blood Institute. (2013). Managing overweight and obesity in adults: Systematic evidence review from the Obesity Expert Panel.

NCD-RisC, Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measure- ment studies in 128.9

million children, adolescents, and adults, lancet 390 (10113) (2017) 2627–2642, https://doi.org/10.1016/S0140-6736(17)32129-3.

Neumark-Sztainer, D., Wall. M., Haines, J., Story, M., & Eisenberg, M.E. (2007). Why does dieting predict weight gain in adolescents? Findings from project EAT-II: a 5-year longitudinal study. *J Am Diet Assoc* 107: 448–455.

Perri, M.G..; Corsica, J.A. Improving the maintenance of weight lost in behavioral treatment of obesity. In: Wadden, TA.; Stunkard, AJ., editors. (2002). Handbook of Obesity Treatment. New York: Guilford; p. 357-379.

Phillipson, A., Swencionis, C., & Wylie-Rosett, J. (2020, November). Effects of Dieting History Before and After a Behavioral Weight Loss Intervention. Poster Presentation at The Obesity Society Conference. Virtual Conference, United States.

Pietilainen, K.H., Saarni, S.E., Kaprio, J., & Rissanen, A. (2012). Does dieting make you fat? A twin study. *International Journal of Obesity*, 36: 456-464.

Pinheiro de Freitas, P. P., de Menezes, M. C., Dos Santos, L. C., Pimenta, A. M., Ferreira, A. V. M., & Lopes, A. C. S. (2020). The transtheoretical model is an effective weight management intervention: a randomized controlled trial. *BMC Public Health*, *20*(1), 1-12.

Poulimeneas, D., Yannakoulia, M., Anastasiou, C.A., & Scarmeas, N. (2018). Weight loss maintenance: have we missed the brain? Brain Sci, 8.

Racine, S.E. & Horvath, S.A. (2018). Emotion dysregulation cross the spectrum of pathological eating: Comparisons among women with binge eating, overeating, and loss of control eating. *The Journal of Treatment and Prevention of Eating Disorders* 26(1): 13-25.

Rhee, E.J., Cho, J.H., Kwon, H., Park, S., Park, C.Y., Oh, K. Park, S.W., Lee, W.Y. (2018). Increased risk for diabetes development in individuals with weight cycling over 4 years: The Kangbuk Samsung Health Study. *Diabetes Research and Clinical Practice*, 139: 230- 238.

Rubenstein, T.B., McGinn, A.P., Wildman, R.P., Wylie-Rosett, J. (2010). Disordered Eating in Adulthood is Associated with Reported Weight Loss Attempts in Childhood. The *International Journal of Eating Disorders*; 43: 663-666.

Spitzer, R.L., Devlin, M., Hasin, D., Wing, R., Marcus, M., Stunkard, A., Wadden, T., Yanovski, S., Agras, S., Mitchell, J., Nonas. (1992). Binge eating disorder: A multisite field trial of diagnostic criteria. *International Journal of Eating Disorders, 11(3),* 191-203.

Swencionis, C., Smith-Wexler, L., Lent, M.R., Cimino, C., Segal, C.J., Ginsberg, M., Caban-Pcai-A., Wassertheil-Smoller, S., Theodore, J.L., Wylie-Rosett, J. (2019). Triggers of Lapse and Relapse of Diet and Exercise in Behavioral Weight Loss. *Obesity,* 27, 888-893.

Teixeira, P. J., Going, S. B., Houtkooper, L. B., Cussler, E.C., Metcalfe, L. L., Blew, R. M., Sardinha, L. B., & Lohman, T. G. (2004). Pretreatment predictors of attrition and successful weight management in women. *International Journal of Obesity, 28*, 1124-1133.

The Methodology Center. Projects using SMART sample size calculator for continuous outcomes. Available at http:// methodology.psu.edu/downloads. Accessibility verified December 31, 2013.

Ufholz, K. & Bhargava, D. (2021). A Review of Telemedicine Interventions for Weight Loss. *Current Cardiovascular Risk Reports,* 15:17.

Unick, J.L., Neiberg, R.H., & Hogan, P.E. (2015). Weight change in the first 2 months of a lifestyle intervention predicts weight changes 8 years later. *Obesity* (Silver Spring) 23:1353-1356.

Vlahoyiannis, A. & Nifli, A.P. (2020). Dietary restraint in associated with adiposity and repeated attempts of food avoidance since early adolescence. *Physiology and Behavior, 218(*1-9).

Wadden T. A., Tronieri J. S., & Butryn, M. L. (2020). Lifestyle Modification Approaches for the Treatment of Obesity in Adults. *American Psychologist, 75*, 235–251 http://dx.doi.org/10.1037/amp0000517

Wang, Y., Beydoun, M.A., Min, J., Xue, H., Kaminsky L.A., & Cheskin, L.J. (2020). Has the prevalence of overweight, obesity, and central obesity levelled off in the United States? Trends, patterns, disparities, and future projections for the obesity epidemic. *International Journal of Epidemiology,* 810-823.

Wilfey. D.E., Haywe, J.F., Balantekin, K.N., Van Buren, D.J., & Epstein, L.H. (2018). Behavioral Interventions for Obesity in Children and Adults: Evidence Based, Novel Approaches and Transition into Practice. *Am. Psychol*. 73(8): 981-993.

Wylie-Rosett J, Swencionis C, Ginsberg M, et al. (2001). Computerized weight loss intervention optimizes staff time: the clinical and cost results of a controlled clinical trial conducted in a managed care setting. *J Am Diet Assoc,* 101:1155-1162.

Yannakoulia, M., Poulimeneas D., Mamalki, E., & Anastasiou, C.A. (2019). Dietary modifications for weight loss and weight loss maintenance. *Metabolism Clinical and Experimental,* 92, 153-162.

Yanovski, S.Z., Marcus, M.D., Wadden, T.A., & Walsh. B.T. (2015). The Questionnaire on Eating and Weight Patterns. Internetional Journal of Eating Disorders, 48(3): 259-261.

Young, M.D., Plotnikoff, R.C., Collins, C.E., Callister, R., & Morgan, P.J. (2016) A Test of Social Cognitive Theory to Explain Men's Physical Activity During a Gender-Tailored Weight Loss Program. *American Journal of Men's Health,* 10(6), 176-187.

Zou, H., Yin, P., Liu, L., Liu, W., Zhang, Z., Yang, Y., Li, W., Zong, Q., Yu, X. (2019). Body-Weight Fluctuation was Associated with Increased Risk for CVD, All-Cause, and CVD mortality: A Systematic Review and Meta-Analysis. Endocrinology 10: 728.