THE RELATIONSHIP BETWEEN SELF-EFFICACY FOR LOW-FAT DIET AND EXERCISE, DIETARY RESTRAINT, AND WEIGHT LOSS

by

Valarie Anne Weinzierl

BS, Pennsylvania State University, 1997

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This essay is submitted

by

Valarie Anne Weinzierl

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and approved by

Essay Advisor:
Janice Zgibor, RPh, PhD _____
Associate Professor of Epidemiology, Medicine, and Clinical Translational Science
Center for Aging and Population Health-Prevention Research Center
University of Pittsburgh

Essay Reader:
Martha Ann Terry, PhD _____
Assistant Professor and Director, MPH Program
Department of Behavioral and Community Health Sciences
Graduate School of Public Health
University of Pittsburgh

Janice Zgibor, RPh, PhD

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ABSTRACT

Objective:

To determine the relationship between self-efficacy and weight loss in participants of the Group Lifestyle Balance (GLB) program with a specific focus on exercise self-efficacy, low-fat diet self efficacy, and dietary restraint.

Subjects:

Sixty non-diabetic adults (21 male, 39 female; age 54.7 ± 10.5 years; BMI, 36.6± 5.6kg/m^2).

Intervention:

Subjects participated in 12 weekly group lifestyle education sessions focused on improving dietary behaviors and increasing physical activity. This study was a pre-post study design with subjects completing baseline and post intervention assessment visits.

Methods:

At baseline, all subjects completed a comprehensive clinical assessment measuring weight, height, waist circumference, blood pressure, cholesterol levels, blood glucose, and other variables relevant for weight management. Baseline assessments also included behavioral and

psychological measures assessing exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint. Subjects completed a 12-session core curriculum and all measures were assessed again at month 3.

Results:

At the end of the 3-month intervention, weight loss was 9.9 ± 7.9 pounds (% change of -4.43, $p<0.0001$). Low fat diet self-efficacy scores increased significantly over the 3 month period ($p=<.0001$) and scores of dietary restraint also showed a significant increase ($p=<.0001$). At 3-month post treatment, measurements of low fat diet self-efficacy and dietary restraint were significantly correlated to weight loss ($r= 0.29$, $p= 0.02$), ($r= 0.34$, $p= 0.008$) respectively. Exercise self-efficacy scores did not change significantly during the 3 months and showed little correlation with weight loss.

Conclusions:

The findings in this study suggest that self-efficacy and dietary restraint play a critical role in achieving weight loss following short term behavioral intervention. Enhancing the cognitive and behaviorally-based lessons in these interventions to increase self-efficacy for weight loss may produce better outcomes. Given that obesity is a public health problem of increasing magnitude, it will be important to provide healthcare workers with the most effective tools for helping participants gain confidence in their ability to practice dietary restraint.

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1. Introduction

During the past 20 years, there has been a dramatic increase in obesity in the United States[1]. It is estimated that 35.7% of U.S. adults are obese, and the prevalence of overweight and obesity combined is now at 68.8%[2]. The health consequences of being overweight or obese are numerous, including an increased risk for coronary heart disease, type 2 diabetes, hypertension, certain types of cancer, and stroke[3]. Fortunately, clinical research trials demonstrate that structured lifestyle programs can produce weight losses of approximately 5% to 10% of initial body weight and lead to significant reductions in health risks[4-7].

There is considerable variability in the individual weight loss response to such lifestyle intervention programs. This has led investigators to explore the thoughts and behaviors that are hypothesized to be associated with successful weight loss and weight maintenance[8-10]. As more is learned about these individual variables, effective strategies can be developed that may enhance outcomes of treatment programs with the potential to reduce the prevalence of obesity and subsequent health risks.

Many variables influence whether an individual is overweight or obese. It is suggested that cognitive, psychological, and behavioral factors can be of particular importance to aid in the weight loss and weight maintenance process[11, 12]. One psychological concept proposed for its role in weight loss is termed self-efficacy. Self-efficacy is a person's belief in his or her ability to succeed in a particular situation [13, 14]. However, many of the behavioral weight loss interventions incorporating this concept have conflicting results, and further investigation is needed to determine the relationship between self-efficacy and weight loss. In several studies, high self-efficacy scores were significantly associated with successful weight loss [15-17]. Conversely, some studies found a much weaker relationship between self-efficacy and weight

loss[18, 19]. In addition, some research has indicated that high self-efficacy for weight loss before treatment may be detrimental to success[20].

When exploring the correlation between self-efficacy and weight loss, most research studies have used the Weight Efficacy Lifestyle (WEL) Questionnaire[21]. This instrument uses a 10-point Likert scale to assess an individual's confidence in his/her ability to resist overeating in 20 tempting situations. To further investigate the role of self-efficacy, it is important to look at a broader array of factors, such as an individual's confidence to be physically active and change their current dietary behaviors. These factors may influence the success in lifestyle change programs.

The objective of this study was to determine the relationship between self-efficacy and subsequent weight loss with a specific focus on exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint among overweight (BMI $\geq 25 kg/m^2$) men and women in a group based behavioral intervention program. This was previously examined in research conducted by Delahanty et al. [22] showing that psychological and behavioral determinants of eating and exercise behaviors were associated with higher BMI in an ethnically diverse group of men and women. In the present investigation, it was hypothesized that participants would demonstrate higher self-efficacy and dietary restraint scores post intervention compared to their baseline scores. A secondary hypothesis was that participants with higher self-efficacy and dietary restraint scores at baseline would demonstrate greater weight loss at three months post intervention compared to those with lower scores.

2. Research Design and Methods

2.1 Study design

The study design was a quasi experimental pre-post design. Enrolled participants completed baseline and post-intervention assessment visits. The post-intervention visit occurred approximately three to four months post-enrollment upon conclusion of 12 group sessions.

This study was conducted by the Diabetes Prevention Support Center (DPSC) at the University of Pittsburgh. The mission of the DPSC is to disseminate an evidence-based diabetes prevention intervention within community settings, specifically known as the Group Lifestyle Balance (GLB) program. The GLB program is a group behavioral lifestyle intervention adapted from the previously successful trial, the Diabetes Prevention Program (DPP)[4]. The GLB program uses the same goals for weight loss and physical activity as the DPP, including achievement of a weight loss of 7% from starting weight, and an increase in physical activity to at least 150 minutes/week through moderate intensity activity (such as a brisk walk).

2.2 Study Participants

A total of 60 adults (39 women and 21 men) participated in the study. The participants were recruited via flyers sent through the University of Pittsburgh campus mail and announcements in local news sources. Concurrently, researchers met with a local YMCA director in Pittsburgh for implementation of the GLB program at this additional site. Information about the GLB program and study was included in a YMCA newsletter sent out to all members. In addition, flyers were mailed to selected zip codes within a four mile radius of the YMCA.

None of the participants had diabetes, were at least 18 years old, and had a body mass index (BMI) $\geq 25 kg/m^2$. The inclusion criteria also required that participants had pre-diabetes (defined as a fasting glucose 100-125 mg/dl)[23] and/or the metabolic syndrome. The National

Cholesterol Education Program ATPIII (NCEP-ATPIII) defines metabolic syndrome as having at least three of the following five conditions: elevated triglycerides (≥150 mg/dl), low HDL cholesterol (40 mg/dl for men, 50 mg/dl for women), large waist circumference (>40 inches for men, >35 inches for women), blood pressure ≥130/85 mm Hg (or on treatment for hypertension), or elevated fasting plasma glucose (≥100 mg/dl)[24].

Previous lab work completed in the medical setting within the year prior to enrollment was used to ensure conditions of eligibility. Individuals with a previous diagnosis of diabetes, women who were currently (or within the past six weeks) pregnant or lactating, any person deemed by his/her physician not to be a candidate, or any person who was planning to leave the area before the end of the study were not eligible. All subjects were required to obtain physician referral to confirm eligibility and to provide permission for physical activity. The University of Pittsburgh Institutional Review Board approved all study procedures prior to implementation.

2.3 Procedures

After providing informed consent, participants chose their preferred time and location for the intervention. The first setting was at a central location at the University of Pittsburgh campus and the second setting was located at a suburban YMCA. Twenty-seven participants enrolled at the University of Pittsburgh site (15 individuals chose the noon group, and 12 individuals chose to take part in the evening group); 33 participants enrolled at the YMCA (15 and 18 in two separate evening groups). The GLB program consisted of 12 core sessions delivered over a period of 12 to 14 weeks which were implemented at both settings.

The program was delivered by two health professionals who had completed the GLB training workshop provided by the DPSC [25]. GLB training workshops cover the background and rationale for the DPP program and lifestyle goals. In addition, the workshops focus on

leading groups and provide an interactive discussion regarding the delivery of the program in specific settings. The health professional for the University setting was an exercise specialist with previous experience in delivering the GLB program. The health professional implementing the program at the YMCA was a registered dietitian with previous group leader experience.

The GLB curriculum consists of 12-sessions designed to be administered weekly in a group setting. The core content includes a broad behavioral focus on principles for making healthy food choices, meal planning, and awareness of calorie and fat content through self-monitoring. All participants received GLB participant handouts, self-monitoring booklets, a calorie and fat counter book, and a pedometer. Each participant was instructed to use the self-monitoring booklets to record his/her daily food and beverage consumption. The calorie and fat counter book was used as a resource for obtaining the calories and fat grams of the foods consumed. In addition, participants were encouraged to record the time of day the foods were consumed and to measure and record portion sizes. Pedometers were provided to encourage participants to increase their physical activity levels and reach the goal of at least 150 minutes per week through moderate intensity activity. Participants met weekly at the sites with each session lasting approximately one hour. In addition, participants were weighed at each group session.

2.4 Measures

Enrolled participants completed baseline and post-intervention assessment visits. The post-intervention visit occurred approximately three to four months post-enrollment upon completion of the 12 core sessions. Trained members of the research team collected all clinical measures. Height and weight were measured twice without shoes with the average computed; BMI was calculated as average weight in kg divided by average height in meters squared (kg/m^2). Waist

circumference was measured at the midpoint between the lower rib margin and the iliac crest; the measurement was repeated twice and the average computed. Blood pressure was measured in a sitting position in the right arm after resting for five minutes. First appearance and last heard (phase V) Korotkoff's sounds were used to define the pressure readings; the measures were repeated twice with a thirty second wait between each reading. An average of the first and second readings was computed. Total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, triglycerides and fasting plasma glucose were measured after at least an eight-hour fast using the Cholestech LDX System, and HbA1c was measured using a DCA machine by a certified research assistant. Participants received their results at each assessment visit. Medication use was assessed via participant interview.

Behavioral and psychological factors were measured at the baseline and post-intervention assessment visits. Participants completed self-administered questionnaires assessing exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint. The 5-item validated exercise self-efficacy scale measured confidence in ability to exercise in various situations, representing negative affect, resisting relapse, and making time for exercise[26]. A 5-point scale is used to rate each item (1 = "not at all confident" and 5 = "very confident"). Low-fat diet self-efficacy was measured with a validated 16-item scale that measures confidence about performing healthy diet behaviors[27]. Stability and internal consistency estimates in the .80s support the scales' reliabilities. Participants rated their confidence on a 5-point Likert scale (1 = "very little confidence" and 5 = "quite a lot of confidence"). Dietary restraint was measured using the 10-item Restraint Subscale of the Dutch Eating Behavior Questionnaire (DEBQ)[28-30]. It has been shown to have high internal consistency and high test-retest reliability across sexes, weight categories, and random samples. Test-retest reliability trials have shown stability for the entire

scale ranging from .74 to .95[31, 32]. Respondents score from 1 to 5 on how often they use 10 different dietary restraint behaviors (1 = never and 5 = very often).

Several lifestyle practices were also assessed through a staff administered questionnaire at baseline and three months post-intervention. Average activity minutes per bout of physical activity, smoking status, and the number of times participants tracked their food intake were among the lifestyle behaviors assessed.

2.5 Statistical Analysis

The primary outcome of the study was change in weight, which was assessed at baseline and three months post intervention. Intention-to-treat analyses were performed for weight only; for those with missing weights at the post-intervention the last documented observation was carried forward. For primary evaluation purposes, the baseline and post-intervention (three months) clinical measures were tested using a paired *t*-test or the non-parametric equivalent when warranted. Paired *t*-tests were conducted to examine the difference in baseline and post-intervention (three months) scores of exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint. Correlations between weight change and measures of self-efficacy and dietary restraint at baseline and three months were examined using Pearson Correlation Coefficient. All data were assessed for normality. If data were not normally distributed, non-parametric methods were used. The Statistical Analysis Software (SAS) (version 9.2, 2002-2008, SAS Institute Inc., Cary, NC) was used for analyses.

To investigate how self-efficacy influenced weight change, subjects were stratified into two groups based on weight loss of ≥5% and ≥7%. The mean difference in scores between baseline and post-intervention were examined by Student's t-test.

3. Results

3.1 Baseline Characteristics

Descriptive baseline characteristics for the 60 enrolled participants are presented in Table 1. The mean age of the participants was 54.7 ± 10.5 years, with the majority being Caucasian (n=54, 90%) and two-thirds female (n=39, 65%). The mean weight (lbs.) was 224 ± 40.1 and mean BMI (kg/m^2) was 36.6 ± 5.6.

Table 1. Baseline Characteristics of Participants in the GLB Program

Characteristics	GLB Cohort
N	*60*
Age(years)	54.7 ± 10.5
Sex	
Male (%)	21(35)
Female (%)	39 (65)
Race	
Caucasian (%)	54 (90)
Non-Caucasian (%)	6 (10)
Weight (lbs.)	224 ± 40.1
BMI (kg/m^2)	36.6 ± 5.6

3.2 Clinical Measures

Clinical measures at baseline and post-intervention (three months) are presented in Table 2. At the post-intervention assessment, overall weight loss was 9.9 ± 7.9 lbs. (% change of -4.43, $p<0.0001$). Significant decreases were also noted for HbA1c (-0.13 ± 0.24, % change of -2.16, $p<0.0001$), systolic blood pressure (-7.0 ± 13.8 mm/Hg, % change of -6.05, $p<0.0004$), diastolic blood pressure (-6.1 ± 8.6 mm/Hg, % change of 7.5%, $p<0.0001$), and waist

circumference (-2.0 ± 1.6 inches, % change of -4.6, p<0.0001). No significant changes were observed for total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides, and glucose.

Table 2. Comparison of Clinical Measures for Baseline vs. Post-intervention (3-month)

Variable	n	Baseline Mean (sd)	n	3-Month Mean (sd)	Mean Change (sd)[e]	% Change	p
Weight (lbs)[a]	58	223.3 (37.9)	58	213.4 (37.2)	-9.9 (7.9)	-4.43%	**0.0001**
Total Cholesterol (mg/dl)[b]	57	179.1 (39.6)	56	177.1 (37.8)	-2.9 (27.9)	-1.12%	0.43
HDL Cholesterol (mg/dl)	58	43.6 (13.6)	58	43.7 (12.4)	+0.1 (9.3)	+0.23%	0.89
LDL Cholesterol (mg/dl)[c]	54	98.5 (31.7)	54	97.7 (30.9)	-0.80	-0.81%	
Triglycerides (mg/dl)	58	186.1 (120.0)	58	172.7 (85.9)	-13.4 (89.9)	-7.2%	0.26
Glucose (mg/dl)	58	103.8 (9.7)	58	103.9 (10.9)	+0.1 (10.3)	+0.09%	0.98
HbA1c (%)	58	6.01 (0.41)	58	5.88 (0.40)	-0.13 (0.24)	-2.16%	**0.0001**
SBP (mmHg)[d]	58	125.7 (15.5)	57	118.1 (11.5)	-7.0 (13.8)	-6.05%	**0.0004**
DBP (mmHg)	58	82.4 (10.1)	57	76.2 (9.2)	-6.1 (8.6)	-7.5%	**0.0001**
Waist (inches)	58	43.4 (4.7)	58	41.4 (4.8)	-2.0 (1.6)	-4.6%	**0.0001**

[a] For missing weight data, the last documented weight was carried forward.
[b] Total Cholesterol < 100 mg/dl for 1 subject at baseline and 2 subjects at post-intervention.
[c] LDL-c could not be calculated for 4 subjects.
[d] Participant with medication changes excluded.
[e] Differences are calculated on the sample with measures at both time points.

3.3 Measure of self-efficacy and dietary restraint

The mean low-fat diet self-efficacy score and dietary restraint score increased significantly over the three month intervention period (Table 3). The mean score for low-fat diet self-efficacy at baseline and post intervention increased significantly (57.60 ± 10.4 vs. 63.16 ± 7.16, p<.0001).

The mean score for dietary restraint measures at baseline and three months post intervention also increased significantly (28.19 ± 5.19 vs. 36.09 ± 5.25, $p<.0001$). However, participants did not demonstrate a significantly higher score for exercise self-efficacy. The mean exercise self-efficacy scores at baseline and three months post intervention were 17.80 ± 4.37 and 17.09 ± 4.13 respectively.

Change in average activity minutes per bout of activity was not statistically significant at three months post intervention. Mean activity minutes per bout of activity at baseline and three months was 32.62 ± 21.83 and 36.12 ± 20.02 respectively.

Table 3. Baseline and post-intervention measures of exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint

Outcome	**Baseline** ***Score (means ± sd)***	**Post (3-month)** ***Score (means ± sd)***	***P*** [a]
Exercise Self-Efficacy	17.80 ± 4.37	17.09 ± 4.13	0.232
Low-Fat Diet Self- Efficacy	57.60 ± 10.4	63.16 ± 7.16	**<.0001**
Dietary Restraint	28.19 ± 5.19	36.09 ± 5.25	**<.0001**

[a] By paired *t* test

3.4 Associations among weight and measures of self-efficacy and dietary restraint.

At baseline, there was little correlation between weight and measures of self-efficacy and dietary restraint (Table 4). At post treatment there continued to be little correlation between weight loss and exercise self-efficacy ($r= 0.12$, $p= 0.36$). However, low-fat diet self-efficacy ($r=0.29$, $p= 0.02$) and dietary restraint ($r= 0.34$, $p= 0.008$) showed a stronger correlation with weight loss at three months.

Table 4. Correlations between weight and measures of exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint at baseline and 3-months

Variable	Baseline		Post (3-month)	
	Correlation coefficient (*r*)	*P*	Correlation coefficient (*r*)	*P*
Exercise self-efficacy	0.11	0.39	0.12	0.36
Low-fat diet self-efficacy	0.12	0.36	0.29	**0.02**
Dietary restraint	0.07	0.58	0.34	**0.008**

Pearson correlation coefficients and *P* value for significance of correlations between self-efficacy and dietary restraint variables and weight loss.

3.5 Measures of self-efficacy and dietary restraint stratified by 5% & 7% weight loss

For participants who lost ≥ 5% of their baseline body weight (n=22), there was no significant difference in their exercise and low-fat diet self efficacy scores at post assessment compared to the scores of those who lost < 5%. However, a significant difference in dietary restraint scores was noted at post assessment for the participants who achieved a ≥5% weight loss, when compared to the scores of those who lost < 5% (Table 5). For those participants who lost ≥7% of their baseline body weight (n=11), there was no significant difference in scores of exercise self-efficacy, low-fat diet self-efficacy, and dietary restraint at post assessment compared to the scores of those participants who lost < 7% (Table 6).

Table 5. Comparison of baseline and 3-month self-efficacy and dietary restraint scores by ≥ 5% weight loss

Variable	Baseline			Post (3-month)		
	Y[a] (n=22) *(mean ± sd)*	**N**[b] (n=36) *(mean ± sd)*	***P***[c]	**Y**[a] (n=22) *(mean ± sd)*	**N**[b] (n=36) *(mean ± sd)*	***P***[c]
Exercise self-efficacy	18.73 ± 3.45	17.22 ± 4.80	0.206	17.50 ± 4.59	16.83 ± 3.86	0.556
Low-fat diet	58.32 ± 9.45	57.17 ± 11.05	0.686	65.04 ± 6.27	62.00 ± 7.49	0.117
Dietary restraint	28.82 ± 4.53	27.81 ± 5.59	0.476	38.23 ± 4.81	34.77 ± 5.14	**0.013**

[a] Y= participants that achieved ≥ 5% weight loss

[b] N=participants that achieved < 5% weight loss

[c] By Student's *t* test

Table 6. Comparison of baseline and 3-month self-efficacy and dietary restraint scores by ≥ 7% weight loss

Variable	Baseline			Post (3-month)		
	Y[a] (n=11) *(mean ± sd)*	**N**[b] (n=47) *(mean ± sd)*	***P***[c]	**Y**[a] (n=11) *(mean ± sd)*	**N**[b] (n=47) *(mean ± sd)*	***P***[c]
Exercise self-efficacy	18.64 ± 3.59	17.59 ± 4.54	0.482	17.55 ± 4.93	16.98 ± 3.97	0.685
Low-fat diet	59.64 ± 7.42	57.13 ± 10.99	0.476	66.27 ± 6.39	62.42 ± 7.19	0.109
Dietary restraint	28.45 ± 5.85	28.13 ± 5.10	0.853	37.91 ± 5.59	35.66 ± 5.14	0.204

[a] Y= participants that achieved ≥ 7% weight loss

[b] N=participants that achieved < 7% weight loss

[c] By Student's *t* test

4. Discussion

The results of this study emphasize the important connections among psychological and behavioral factors and weight management. Specifically, results indicated that participants gained more confidence in their ability to perform healthy diet behaviors during the intervention (i.e. increased self-efficacy). In addition, self-efficacy to eat a low-fat diet as well as self-efficacy to resist eating specifically to control body weight was associated with more weight loss. This indicates that improving self-efficacy over the course of the intervention, particularly for dietary behaviors, could be more important for achieving weight loss than self-efficacy at baseline. These findings are consistent with results from other studies showing that changes in low-fat diet self-efficacy and dietary restraint skills predicted better long-term weight loss, and the association of low-fat diet self-efficacy with weight outcomes was explained by dietary behaviors[33]. Finally, results of this study also demonstrated no significant difference between exercise self-efficacy scores at baseline and post intervention.

Improvements in the behaviors associated with dietary restraint, and the confidence that one has in achieving these behaviors, appear to be important factors in successful weight loss based on these study results. The core intervention curriculum used in this study focused on coaching and interpreting behavioral skills. Participants were encouraged to set small achievable goals, self-monitor their food and beverage consumption, balance fat gram intake including options for reducing fat intake, stimulus control, problem solving, and managing stress or high-risk situations. These learned behaviors could explain the improvement in low-fat diet self-efficacy and dietary restraint scores measured.

When participants develop skills and learn techniques for tightly controlling their food intake (dietary restraint), they decrease their total calorie level which results in weight loss.

Previous research has confirmed the positive effect of restrained eating on weight loss and has shown that dietary restraint is associated with lower BMI levels, even in the absence of a dietary intervention. This suggests that restrained eating behaviors, rather than dieting per se, contribute to successful weight management[34]. Interestingly, some research has shown that very high levels of dietary restraint are not associated with successful weight management and may lead to abnormal eating patterns[35]. However, in this behavior self-management intervention, participants practiced flexible dietary restraint behaviors. Participants learned skills of setting calorie and fat goals and adequately responding to episodes of overeating or weight gain by eating less and balancing calorie and fat intake over a period of time. Therefore, it is likely that participants did not have episodes of drastic decreases in calories and/or fat intake but instead, made adjustments over days or weeks and were able to achieve their goals.

In this study, there was no significant difference between exercise self-efficacy scores at baseline and post intervention. In other words, these results demonstrated that there was no change in the participants' confidence to accomplish the moderate physical activity goals during this three month intervention. Therefore, as would be expected, the results also indicated that exercise self-efficacy had no effect on weight loss among the participants. In addition, self-reported average physical activity minutes per bout of activity indicated no significant change from baseline to post intervention.

There are a few possible reasons the results indicated no change in exercise self-efficacy within this behavioral program. One relates to the sensitivity of the questionnaire which consisted of only five brief questions assessing exercise self-efficacy. This could result in insufficient data to determine the participants' true confidence to participate in regular activity. Another possible reason for an absence of change in exercise self-efficacy during this

intervention relates to the amount of information and emphasis on physical activity during the program. Although energy balance was continually reinforced during the three month intervention, only two of the 12 sessions focused on physical activity. In addition, it is important to note that half of the participants in this study were coached by a registered dietitian. Therefore, it is possible that dietary behaviors were emphasized more often during the intervention sessions, resulting in a decreased focus on physical activity and achieving the appropriate physical activity goals.

Although the study results showed a significant weight loss of 4.43%, this is not considered to be a clinically meaningful weight loss (5%)[36]. It is possible that with further emphasis and education on achieving physical activity goals during this intervention, the weight loss results could have reached a more clinically significant level and exercise self-efficacy scores would have improved as a result.

When separating the participants into two groups based on their level of weight loss (lost ≥ 5%, or lost ≥ 7%), participants who achieved ≥ 5% weight loss demonstrated significantly better scores on dietary restraint from baseline to three months post intervention. Exercise self-efficacy and low-fat diet self efficacy scores did not change significantly for those participants who achieved ≥ 5% and ≥ 7% weight loss. However, the sample size of these weight loss groups was very small, with 22 participants achieving ≥ 5% and only 11 participants achieving ≥ 7% weight loss. Therefore, these results should be viewed with caution and considered exploratory.

Another limitation of this study is the short duration of the intervention. Several efficacy trials and behavioral lifestyle interventions have shown a minimum of four to six months of frequent intervention contact to induce clinically meaningful weight loss of 5% of initial body weight[37, 38]. In addition, research has shown that behavioral based treatment resulted in a 6.6 lb

greater weight loss in intervention participants compared to control participants after 12 to 18 months, with more treatment sessions associated with greater weight loss[39]. Weekly contact during the first several months of an intervention, followed by less frequent but regular therapeutic contact for a longer period, seems necessary for participants to adopt behavior change skills that will enable weight loss results[40]. Therefore, it is expected that with a longer intervention period, including an interactive process of feedback and social support, there would be a greater increase in self-efficacy, skill development, and weight loss.

In addition to the small sample size of this study and the short duration, another limitation of this study is that physical activity and eating habits were all self-reported. Self-reported data can result in bias and variability errors, since participants tend to report what reflects positively on their own abilities, knowledge, and beliefs[41]. It is widely recognized that when people self-report their dietary intake, many underestimate their food, nutrient, and related energy intake. Some studies have found that 27% to 46% of women with overweight and obesity underreport their energy intake [42, 43]. Further exploration of newer technologies is needed to investigate means for increasing the validity of self-reported dietary intake and physical activity.

In conclusion, successful weight loss and the achievement of a healthy weight are influenced by multiple factors. These study findings show that self-efficacy plays an important role in weight loss. In addition, participating in a group lifestyle education program that emphasizes behavioral learning skills is an effective strategy for increasing self-confidence to achieve weight loss. In particular, participants' confidence to resist eating in situations where food is readily available is a positive predictor of weight loss. These results have clinical implications for the inclusion of behavioral skill building exercises focused on increasing self confidence in future weight loss interventions. Future research studies should be designed to

further explore the relationship between self-efficacy and longer term weight loss within this high-risk population.

APPENDIX A

GROUP LIFESTYLE BALANCE:

BEHAVIORAL, DIET, AND ACTIVITY QUESTIONNAIRE

Participant ID | | | | | |

Outcome visit | B | 4M | 8M | 12M |

Date of visit | | | | | | | | | | |
month day year

Group Lifestyle Balance

Behavioral, Diet, and Activity Questionnaire

This form is self administered by the participants at all visits. Read and follow instructions given for each section.

A. Exercise Self-Efficacy

Beside each item below, please mark an 'X' in the box indicating how much confidence you have about performing it. Rate your confidence on a scale of 1-5, where '1' indicates 'Not at all confident' and '5' indicates 'Very confident'.

1. I am confident that I can participate in regular exercise when:

CHECK ONLY ONE FOR EACH QUESTION

	Not at all confident				**Very confident**
a. I am tired……	1	2	3	4	5
b. I am in a bad mood……	1	2	3	4	5
c. I feel I don't have the time……	1	2	3	4	5
d. I am on vacation……	1	2	3	4	5
e. It is raining or snowing……	1	2	3	4	5

Participant ID | | | | | |

Outcome visit | B | 4M | 8M | 12M |

Date of visit _____ month _____ day _____ year

B. Low-Fat Diet Self-Efficacy

Beside each item below, please mark an 'X' in the box indicating how much confidence you have about performing it. Rate your confidence on a scale 1-5, where '1' indicated 'Very little confidence' and '5' indicates 'Quite a lot of confidence'.

CHECK ONLY ONE FOR EACH QUESTION

	Very Little Confidence				**Quite a Lot of Confidence**
1. Reaching my ideal weight by eating healthy food……	1	2	3	4	5
2. Decreasing amount of fat and cholesterol in my diet……..	1	2	3	4	5
3. Staying on a healthy diet when I am busy or in a rush……..	1	2	3	4	5
4. Staying on a healthy diet when no one at home is on it……..	1	2	3	4	5
5. Staying on a healthy diet when I eat at a restaurant……	1	2	3	4	5
6. Staying on a healthy diet when I am not at home……	1	2	3	4	5
7. Staying on a healthy diet on special occasions/holiday……..	1	2	3	4	5
8. Knowing what foods I should eat on a healthy diet……..	1	2	3	4	5
9. Cutting out unhealthy snacks during the day/evening……	1	2	3	4	5
10. Increasing amount of fiber and vegetables in my diet……	1	2	3	4	5
11. Staying at an ideal weight once I have reached it……..	1	2	3	4	5
12. Knowing how to cook healthy meals……..	1	2	3	4	5
13. Preparing healthy meals for myself when I eat alone……	1	2	3	4	5
14. Limiting the number of egg yolks I eat in a week……	1	2	3	4	5
15. Knowing what food to buy at the store……	1	2	3	4	5
16. Decreasing the amount of sugar and sweets in my diet……..	1	2	3	4	5

Participant ID | | | | | |

Outcome visit | B | 4M | 8M | 12M |

Date of visit | | | | | | | | | | |
month day year

C. Dietary Restraint

Rate each item below on a scale of 1-5, where 1 = 'Never', 2 = 'Seldom', 3 = 'Sometimes', 4 = 'Often', 5 = 'Very often'.

CHECK ONLY ONE FOR EACH QUESTION

	Never	Seldom	Sometimes	Often	Very often
1. When you have put on weight, do you eat less than you usually do?	1	2	3	4	5
2. Do you try to eat less at mealtimes than you would like to eat?	1	2	3	4	5
3. How often do you refuse food or drink offered because you are concerned about your weight?	1	2	3	4	5
4. Do you watch exactly what you eat?	1	2	3	4	5
5. Do you deliberately eat foods that are slimming?	1	2	3	4	5
6. When you have eaten too much, do you eat less than usual the following day?	1	2	3	4	5
7. Do you deliberately eat less in order not to become heavier?	1	2	3	4	5
8. How often do you try not to eat between meals because you are watching your weight?	1	2	3	4	5
9. How often in the evenings do you try not to eat because you are watching your weight?	1	2	3	4	5
10. Do you take into account your weight with what you eat?	1	2	3	4	5

APPENDIX B

GROUP LIFESTYLE BALANCE:

LIFESTYLE INFORMATION QUESTIONNAIRE

PRE POST 8MO 12MO ID#_____ DATE____/____/____

LIFESTYLE INFORMATION

1. **Current Smoking** (within past 6 weeks) YES=1 NO=0 2.	
3. **First degree relative with diabetes?** YES=1 NO=0 4.	
5. **First degree relative with heart disease?** YES=1 NO=0 6.	
7. **Physically active on 3 or more days/week?** YES=1 NO=0 8.	
9. **How often does the participant weigh his/her self?** • Daily=1 (5-7 times/week) • 2-4 times/week=2 • Once per week=3 • 2-3 times/month=4 • Less than 1/month or never=5	
10. **Lifestyle Practices: How often does the participant keep track of food intake?** • Daily=1 (5-7 times/week) • 2-4 times/week=2 • Once per week=3 • 2-3 times/month=4 • Less than 1/month or never=5	
11. **How often does the participant meet fat and calorie goals?** • Daily=1 (5-7 times/week) • 2-4 times/week=2 • Once per week=3 • 2-3 times/month=4 • Less than 1/month or never=5 • Not applicable=888	
12. **How often does the participant perform physical activity?** • Daily=1 (5-7 times/week) • 2-4 times/week=2 • Once per week=3 • 2-3 times/month=4 • Less than 1/month or never=5	
13. **How often does the participant keep track of physical activity?** • Daily=1 (5-7 times/week) • 2-4 times/week=2 • Once per week=3 • 2-3 times/month=4 • Less than 1/month or never=5 • Not applicable=888	
When the participant is active, how many minutes is he/she active on average? _____	

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