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Heontae Kim

*University of Mississippi*

Taeyeon Oh

*University of Mississippi*

Natalie M. Papini

*Northern Arizona University*

Nanette V. Lopez

*Northern Arizona University*

Stephen D. Herrmann

*Sanford Health*

*See next page for additional authors*

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**Authors**

Heontae Kim, Taeyeon Oh, Natalie M. Papini, Nanette V. Lopez, Stephen D. Herrmann, and Minsoo Kang

# Patterns of Weight Change in a Commercial Weight Loss Program

Heontae Kim, PhD

Taeyeon Oh, PhD

Natalie M. Papini, MA

Nanette V. Lopez, PhD, MS/MS

Stephen D. Herrmann, PhD

Minsoo Kang, PhD

**Objectives:** In this study, we examined compliance and progress factors associated with weight loss and maintenance, individual patterns of weight trends following weight loss, and impact of early weight loss on longer-term weight change. **Methods:** We conducted secondary analysis of pre-post data. Participants were 8769 persons (mean age = 47.63 ± 13.78 years; 77.74% women; mean weight = 97.20 ± 22.82 kilograms; BMI = 34.09 ± 6.84) in a commercial weight management program. We carried out multiple regression analyses on weight change and percentage, and used ANOVA and the Pearson chi-square test to examine participant characteristics, weight change patterns, and early weight loss success. **Results:** Participants were active in the program for 222 ± 158 days, completed 15 ± 13 appointments, achieving -8.53 ± 7.87 kilograms lost (-8.61% ± 7.64%). Greater weight loss was associated with appointment frequency ( $\beta = -0.46$ ) and total spending ( $\beta = -2.89$ ) ( $p < .01$ ). We identified 5 weight change patterns ( $F = 37.56$ ,  $p < .001$ ) (total weight loss for each group was: Stable = -10.4% [N=2036]; Minimal Regain = -10.5% [N=3766]; Modest Regain = -8.8% [N=1476]; Large Regain = -7.3% [N=753]; No Loss/Gain = +3.7% [N=737]; all  $p < .05$ ). Over 5000 participants achieved early weight loss (losing > 5%) within the first 2 months resulting in significantly greater final weight loss (-8.43% to -14.56% vs -1.18% to -3.15%). **Conclusions:** We identified several weight patterns; increased health coaching attendance was associated with greater weight loss.

**Key words:** weight management; health coaching; weight loss; weight loss maintenance weight gain; public health

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From 1999 through 2018, the prevalence of obesity increased from 30.5% to 42.4% with a concomitant doubling of obesity severity.<sup>1</sup> Adults with overweight and obesity are at greater risk for developing adverse health outcomes, such as type 2 diabetes mellitus, cardiovascular disease, hypertension, and certain cancers (eg, endometrial cancer, breast cancer, prostate cancer, and colon cancer).<sup>2</sup> Research indicates that successful prevention and treatment of obesity are likely to result in lower incidences of chronic diseases.<sup>3</sup>

According to the 2013-2016 National Health and Nutrition Examination Survey, 49.1% of United States (US) adults (women: 56.4%; men: 41.7%) attempted to lose weight in the last 12 months.<sup>4</sup> Behavioral weight

loss interventions commonly target physical activity and diet to modify weight and prevent chronic conditions.<sup>5</sup> Commercial weight loss programs provide behavioral interventions, and many Americans enroll in commercial weight loss programs as obesity treatment options. WW™ (formerly WeightWatchers), NutriSystem™, and Medifast® are popular commercial programs dominating market share.<sup>6</sup> Two systematic reviews evaluated the effectiveness of the largest commercial weight loss programs in the US using meta-analytic procedures.<sup>6,7</sup> They concluded that some commercial weight loss programs elicited significant weight reductions; however, limitations of many commercial weight loss programs include programs of short duration (12 months or less), high rates of attrition, and lack of examination of long-term effects.

Heontae Kim, Data Analyst, Institute of Child Nutrition, University of Mississippi, University, MS, United States. Taeyeon Oh, Assistant Professor, University of Mississippi, University, MS, United States. Natalie M. Papini, Doctoral Student and Nanette V. Lopez, Assistant Professor, Northern Arizona University, Flagstaff, AZ, United States. Stephen D. Herrmann, Senior Director of Research and Innovation, Sanford Research, Sioux Falls, SD, United States. Minsoo Kang, Professor and Chair of Health, Exercise, and Recreation Management, University of Mississippi, University, MS, United States.  
Correspondence Ms Papini; [Natalie.Papini@nau.edu](mailto:Natalie.Papini@nau.edu)

Short-term weight loss is challenging, yet commonly observed; however, maintaining weight loss long-term is difficult to achieve.<sup>8</sup> Because of the high attrition rates reported in commercial weight loss programs and little evidence of long-term outcomes, it is crucial to identify factors that lead to long-term weight maintenance. Additionally, identifying effective strategies for use by commercial weight loss programs in achieving and maintaining appropriate body weight for clients are warranted. Regardless of these factors, improved success is related to intervention delivery format (eg, behavioral weight management lead by health coaches in individual or group settings vs do-it-yourself) and intensity (ie, number of meetings and length of intervention).<sup>9,10</sup>

The purpose of this study is to understand how components of a weight management program impact weight change over time. Additionally, we examined trends of weight change to understand weight loss and weight regain patterns in adults with overweight and obesity enrolled in a commercial weight management program. Furthermore, in this study, we address future research directions noted by Jensen et al<sup>2</sup> by trying to understand which mechanisms of a commercial weight management program (such as total number of health coaching appointments or individual spending variations) may promote additional weight loss after 6 months (a common time when weight loss plateaus occur). Understanding which features of weight management programs are most useful in long-term weight maintenance can inform future intervention designs and guide existing interventions on how to best allocate resources. To achieve this, we examined (1) compliance and progress factors (eg, number of the completed appointments, the amount of spending on the commercial weight management program, membership duration, weight-loss pattern) that influence weight loss, (2) the characteristics of individuals based on their weight trend following weight loss (ie, weight regain, weight maintenance) and (3) the impact of early weight loss success on long-term weight changes.

## METHODS

### Participants

The data were collected between May 2017 and January 2019 as part of the Profile by Sanford weight management program. All data were de-identified. A total of 18,991 individuals were reviewed for study eligibility. Inclusion criterion included adults (18 years or older), with a BMI  $\geq 25$  (overweight or obesity), who were not pregnant, and enrolled in the commercial behavioral weight management program. Potential participants were removed based on the following exclusion criteria: no weight records, no appointment records, and participants enrolled in a program for women who are pregnant or trying to conceive. Outliers were defined as weight changes larger or smaller than 4 standard deviations of (1) individual's weight loss,

(2) percentage weight change in the first month, and (3) percentage weight change in the second month. All potential participants meeting outlier criteria were excluded, which resulted in a final sample of 8769 participants.

### Weight Management Program

Participants were enrolled in a commercial behavioral weight management program (hereby referred to as 'the program') that included unlimited health coaching. The average cost to enroll in the program for one year was \$150 USD. Memberships were renewed or discontinued on a yearly basis. Memberships covered the cost of a Wi-Fi enabled body weight smart scale that automatically synced with their online account, the online account, a tailored meal plan, and access to a health coach.

Health coaches were trained to provide education targeting program protocols, diet, physical activity, and lifestyle behaviors. Health coaches received 40 hours of training on nutrition protocols, motivational interviewing, and behavior change strategies. Coaches became certified after passing an exam and practicing health coaching skills under supervision of experienced trainers. Participants were encouraged to set behavioral goals and had access to weekly one-on-one health coaching sessions. Appointments were 30 minutes in length and occurred either face-to-face, over the phone, or through video conferencing. Participants scheduled appointments with a health coach in advance and were not required to meet with the same health coach at every appointment. Participants who attended coaching appointments reviewed their progression toward previously identified goals and received education on topics such as nutrition label reading, food groups, meal planning, exercise basics, stress management, and social support. Behavioral strategies coaches assisted members in developing include, but are not limited to self-monitoring, goal setting, restructuring of the environment to support health habits, recognition of hunger and satiety cues, and portion control.

The program consisted of 3 phases designed to change as a participant transitioned from weight loss into weight maintenance: (1) a weight loss phase, (2) a transition phase, and (3) a weight maintenance phase. Dietary behaviors promoted during the weight loss phase focused on consumption of a combination of minimally processed foods purchased at grocery stores (eg, minimum of 4 cups of vegetables per day and a home cooked meal) along with meal replacements purchased from the program. Participants purchased meal replacements needed for the weight loss phase independent of enrollment fees, with average costs totaling \$80 USD per week initially and decreasing across phases. In the transition phase, consumption of minimally processed grocery foods was increased, and meal replacements were reduced. Dietary behaviors promoted during the weight maintenance phase

included primary consumption of grocery foods using a meal plan based on the US Department of Agriculture's MyPlate recommendations.<sup>11</sup> Participants were encouraged, though not required, to continue consumption of meal replacements in the weight maintenance phase for convenience, nutritional value, and demonstrated efficacy in long-term weight maintenance.<sup>12</sup> Participants transitioned through the program phases at their own pace based on individualized goals. All participants received a Wi-Fi enabled body weight smart scale that automatically synced with their online account, which contained their individual progress information, education, and meal plans. Health coaches had access to online accounts and utilized them during appointments to track progress and discuss transition to the next phase.

### Study Variables

Prior to statistical analyses, we created operational definitions for each variable. Demographic information included sex, age, height, date of birth, and total spending in USD. Total spending was tracked as a proxy for nutrition plan compliance with meal replacements. All weight loss plans included meal replacements purchased from the program; grocery foods were purchased independently. Meal replacements were not included in the annual \$150 program fee. Individuals adhering to their meal plan generally spent \$80 per week on meal replacements in the weight loss phase of the program. Status for each appointment was reported as 'completed', 'no show' or 'cancelled'. Completed appointments indicated the participant attended the coaching appointment in-person or via phone/video technology. No-show appointments indicated the participant did not show up for a scheduled appointment. Cancelled appointments indicated the participant cancelled the appointment prior to the appointment date. Weight was defined as the participant's weight in kilograms as collected by an at-home Wi-Fi enabled body weight smart scale, which transmitted information for each date of measurement. Membership duration was the difference between the day of the first recorded appointment and the last recorded appointment. Monthly appointment frequency was defined as the number of completed appointments (excluding no shows and cancelled appointments) per 30 days. Weight loss was recorded as the difference between participant weight recorded on their last day and their initial weight recorded on their first day. Likewise, percentage weight change was defined as the relative weight changes of individuals according to their weight of enrollment (last weight minus first weight divided by first weight and multiplied by 100). Weight regain was defined as the degree of increase in body weight compared to the lowest weight recorded and was calculated by subtracting the lowest weight from the last weight recorded.

### Weight Change Patterns

Weight management guidelines advanced by the American Heart Association, the American College of Cardiology, and The Obesity Society (AHA/ACC/TOS)<sup>2</sup> indicate that 5% weight loss is associated with improvements in many chronic conditions. However, weight regain is common among people seeking weight loss treatments.<sup>13</sup> Participants were categorized into 5 groups based on their weight regain pattern. In this study, the 5 groups were defined as: Stable – participants who lost weight and never regained weight; Minimal Regain – participants who lost weight and later regained a minimal amount ( $\leq 5\%$ ) from their lowest weight; Modest Regain – participants who lost weight and later regained a modest amount ( $> 5$  to  $\leq 10\%$ ) from their lowest weight; Large Regain – participants who lost weight and later regained greater than 10% of their lowest weight; and No Loss/Gain – participants who never lost weight, gained, or lost and gained above baseline.

### Early Success

Early weight loss (weight lost within the first 2 months) has been shown to be predictive of weight loss at 4 and 8 years.<sup>14</sup> In this study, early success was defined in 4 groups by percent of weight lost in the first month or first 2 months (None: 0%, Good:  $> 0\%$  to 5%, Better:  $> 5\%$  to 10%, Best:  $> 10\%$ ).

### Data Analyses

We used several statistical tests, including multiple regression, ANOVA, and Pearson's chi-square to analyze the data. To identify factors that influence individuals' weight loss and maintenance, we conducted multiple regression separately on the weight loss and percentage weight change outcomes, and controlled for demographic and anthropometric variables such as age, sex and height. We used ANOVA to examine characteristics of individuals (monthly appointment frequency and age) based on their weight change trend. Pearson's chi-square test was used for categorical variables (sex). We examined the impact of early success on weight changes by running ANOVA on early success in the first month and first 2 months, separately. We conducted all statistical analyses using STATA 14.0 software (College Station, TX).

### RESULTS

Table 1 shows the descriptive statistics of individuals. Among 18,991 initially screened individuals, 8769 participants (women = 6817 [77.74%]) were included. The mean age of participants was 47.63 years, their average total spending was \$1370 USD (about \$6.17 USD per day on meal replacements), and their average membership duration (defined by time from first to last appointment) was 222.04

**Table 1**  
**Descriptive Statistics of Participants**

Variables	Mean (SD)	Min	Max	Med
Height (cm)	168.50 (9.12)	142.24	213.36	167.64
Initial weight (kg)	97.20 (22.82)	47.69	249.47	93.39
Age (years)	47.63 (13.78)	18.00	88.07	48.16
Total spending (USD, thousands)	1.37 (1.11)	0.00	10,868.57	1.05
Membership duration (d)	222.04 (157.99)	1.00	643.00	193.00
Appointment per month	2.31 (1.19)	0.06	30.00	2.19
Appointment total	14.87 (12.98)	1.00	81.00	11.00
Weight change (kg)	-8.53 (7.87)	-36.26	25.10	-7.07
Weight change (%)	-8.61 (7.64)	-38.23	33.70	-7.58
Number of Participants		8769		
Men		1952 (22.26%)		
Women		6817 (77.74%)		

**Note.**

SD = standard deviation; Min = minimum; Max = maximum; Med = median; d = days, kg = kilograms, cm = centimeters

**Table 2**  
**Factors that Influence Participants' Weight Loss**

Variables	Model 1 (DV: WL)			Model 2 (DV: % change)		
	$\beta$	SE	p	$\beta$	SE	p
Monthly Appointment frequency	-0.48	0.06	< .001	-0.46	0.06	< .001
Total spending (USD)	-2.96	0.07	< .001	-2.89	0.07	< .001
Height (cm)	-0.17	0.03	< .001	0.05	0.03	.090
Age (years)	-0.00	0.00	.231	-0.01	0.01	.015
Sex	2.70	0.25	<.001	1.91	0.25	< .001
(Constant)	5.96	2.11	.001	-7.64	2.08	.001
R-square	0.21			0.19		

**Note.**

DV = dependent variable; WL = weight loss;  $\beta$  = Beta coefficient; SE = standard error; % change = weight change percentage, USD = US dollars; cm = centimeters

days (7.43 months). The participants completed 2.31 appointments per month and averaged 15 total appointments. Participants lost 8.53 kg on average, approximately -8.61% of their starting weight.

**Weight Loss Factors**

To examine factors that influence participants' weight loss, we applied regression analyses on the weight loss and percentage weight change outcomes and controlled for demographic variables including age and sex, along with participant height. Significant negative standardized beta coefficients for the independent

variables, monthly appointment frequency, and total spending (ie, meal replacement adherence) were seen in both models. Monthly appointment frequency ( $\beta = -0.48$ ) and total spending ( $\beta = -2.96$ ) had a statistically significant effect on weight loss ( $p < .001$ ). Monthly appointment frequency ( $\beta = -0.46$ ) and total spending ( $\beta = -2.89$ ) had a statistically significant effect on percentage weight change ( $p < .001$ ; Table 2). The results indicated that participants lost more weight if they had more frequent appointments and spent more money adhering to their nutrition plan. Specifically, the results showed that completion of one additional appointment per month resulted in a 0.48 kg weight

loss, or 0.46% more body weight lost.

### Weight Change Patterns

To determine characteristics of individuals based on their weight loss and regain pattern, we separated the participants into 5 groups and tested mean differences in monthly appointment frequency, age, and sex among these groups. Figure 1 shows weight change patterns including baseline weight, lowest weight, and last recorded weight. Stable participants lost weight and maintained a 10% weight loss. The Minimal Regain, Modest Regain, and Large Regain groups lost a significant amount of weight from their baseline weight to their lowest weight (Minimal Regain = -12.3%; Modest Regain = -14.9%; Large Regain = -19.9% all  $p < .05$ ) and later regained some weight with those groups still ending at  $> 5\%$  loss (total weight loss for Minimal Regain: -10.5%; Modest Regain: -8.8%; Large Regain: -7.3% all  $ps < .05$ ). The No Loss/Gain group was comprised of those who never lost weight, gained weight, and those who lost and then gained weight, resulting in a weight change from baseline to their lowest weight of -7.1% and total weight change of +3.7% (both  $ps < .05$ ). Of all participants, 83% maintained 5% or greater weight loss (stable, minimal, and modest groups).

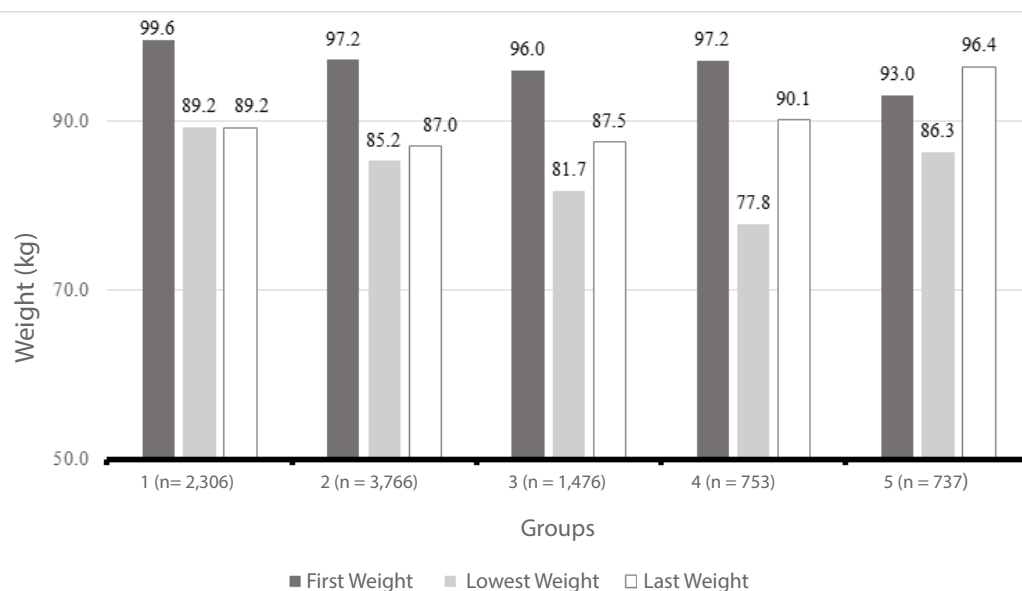
Monthly appointment frequency appeared to have a strong relationship with weight regain; greater

appointment frequency was associated with less regain (ie, improved weight loss maintenance) ( $F(4,8,764) = 37.56, p < .001$ ). Monthly appointment frequency was highest in the Stable Group (2.48) and significantly decreased across groups in a linear order (Table 3). Participant age among groups was significantly different ( $F(4,8,764) = 43.08, p < .001$ ); however, it did not follow a linear pattern (Table 3). Participants in Minimal Regain (48.48 years), Modest Regain (49.52 years), and Large Regain (49.03 years) groups were slightly older than Stable (45.91 years) participants, and those in No Loss/Gain were the youngest (42.89 years). According to the Pearson chi-square test, sex was significantly different among groups ( $\beta = 47.15, p < .001$ ; Table 4) with the largest difference observed in No Loss/Gain group, with a greater proportion being women.

### Early Success

We examined the impact of weight loss in the first month and first 2 months on total weight loss. For the entire sample, average weight loss in the first month was  $5.59\% \pm 2.66\%$ , and  $7.63\% \pm 3.82\%$  in the first 2 months. Early success was classified into 4 groups (None: 0%, Good:  $> 0\%$  to 5%, Better:  $> 5\%$  to 10%, Best:  $> 10\%$ ) for weight lost within the first month and within the first 2 months. Greater final weight loss was observed in the groups with greater early success within the first month and first 2 months (Table 5;

**Figure 1**  
Baseline Weight, Lowest Weight, and Last Weight by Weight Change Group



#### Note.

Group 1: Stable = individuals who lost weight and never regained; Group 2: Minimal Regain = individuals who lost weight and whose weight regain was  $\leq 5\%$  of their lowest weight; Group 3: Modest Regain = individuals who lost weight and whose weight regain  $> 5$  to  $\leq 10\%$  of their lowest weight; Group 4: Large Regain = individuals who lost weight and whose weight regain was  $> 10\%$  of their lowest weight; Group 5: No Loss/Gain = individuals who never lost weight, gained, or lost and gained above baseline.

**Table 3**  
**Differences in Monthly Appointment Frequency and Age according to Weight Change Pattern**

Group	Sample N (%)	Monthly Appointment Frequency (SD)	Age Years (SD)	Weight Regain kg (%)
Stable	2037 (23.23)	2.48 (1.46)	45.91 (14.15)	0 (0)
Minimal Regain	3766 (42.95)	2.38 (1.11)	48.48 (13.91)	1.77 (2.08)
Modest Regain	1476 (16.83)	2.16 (0.97)	49.52 (12.87)	5.83 (7.13)
Large Regain	753 (8.59)	2.13 (0.99)	49.03 (12.31)	12.32 (15.83)
No Loss/ Gain	737 (8.40)	1.99 (1.29)	42.89 (13.69)	10.10 (11.70)
F <sub>(4,8,764)</sub>		37.56	43.08	4,392.53
p		< .001	< .001	< .001

**Note.**

SD = standard deviation; Stable = individuals who lost weight and never regained; Minimal Regain = individuals who lost weight and whose weight regain was ≤ 5% of their lowest weight; Modest Regain = individuals who lost weight and whose weight regain > 5 to ≤ 10 % of their lowest weight; Large Regain = individuals who lost weight and whose weight regain was > 10% of their lowest weight; No Loss/Gain = individuals who never lost weight, gained, or lost and gained above baseline.

**Table 4**  
**Differences in Sex according to Weight Change Pattern**

Group	Sex		Pearson's $\chi^2$	p
	Men N (%)	Women N (%)		
Stable	461 (22.63)	1576 (77.37)	47.15	< .001
Minimal Regain	796 (21.14)	2970 (78.86)		
Modest Regain	384 (26.02)	1092 (73.98)		
Large Regain	202 (26.83)	551 (73.17)		
No Loss/ Gain	109 (14.79)	628 (85.21)		
Total	1952 (22.26)	6817 (77.74)		

**Note.**

Stable = individuals who lost weight and never regained; Minimal Regain = individuals who lost weight and whose weight regain was ≤ 5% of their lowest weight; Modest Regain = individuals who lost weight and whose weight regain > 5 to ≤ 10 % of their lowest weight; Large Regain = individuals who lost weight and whose weight regain was > 0% of their lowest weight; No Loss/Gain = individuals who never lost weight, gained, or lost and gained above baseline; the no loss/gain group had a significantly higher proportion of women than all other groups.

all ps < .001). Participants (N=5438) who experienced early success of greater than 5% weight loss in the first month achieved final weight loss ranging from -10.69% to -14.56%. Individuals (N=6552) who achieved early success of greater than 5% weight loss in the first 2 months resulted in final weight loss ranging from -8.43% to -14.15%.

**DISCUSSION**

In the present study, we investigated weight change

patterns among individuals enrolled in a weight management program that included health coaching and structured dietary recommendations. Results showed that participants who attended more frequent health coaching appointments, more health coaching appointments overall, and used more meal replacements as part of their nutrition plan, were most successful. Patterns of weight loss, maintenance, and regain were observed with the majority of participants (91.6%) maintaining clinically significant weight loss of > 5%.



**Table 5**  
**Impact of Early Success in First Month and First 2 Months on Total Weight Change**

One-month success Criteria	Total weight change from first to last weight		2-month success Criteria	Total weight change from first to last weight	
	(kg)	(%)		(kg)	(%)
None: 0% (N=311)	-3.19	-3.15	None: 0% (N=227)	-1.24	-1.18
Good: > 0% to 5% (N=3020)	-4.96	-5.05	Good: > 0% to 5% (N=1990)	-3.00	-3.04
Better: > 5% to 10% (N=5140)	-10.57	-10.69	Better: > 5% to 10% (N=4104)	-8.24	-8.43
Best: > 10% (N=298)	-15.03	-14.56	Best: > 10% (N=2448)	-14.18	-14.15
<b>F</b>	515.00	545.41	<b>F</b>	1131.65	1205.19
<b>df1/df2</b>	3/8,765	3/8,765	<b>df1/df2</b>	3/8,765	3/8,765
<b>p</b>	< .001	< .001	<b>p</b>	< .001	< .001

Lastly, participants who experienced early weight loss within the first 2 months were more successful.

The frequency of monthly health coaching appointments was significantly associated with greater weight loss. Attending one additional appointment per month resulted in a weight loss of 0.48 kg (0.46%). Compared to those who regained weight and those who never lost weight, the most successful group of participants who lost weight and did not experience weight regain (N=2036; 23.22%) attended the most health coaching appointments. Previous studies investigated the psychological aspects that impact obesity, and obesity-related outcomes.<sup>15,16</sup> Several psychological factors such as self-motivation, self-efficacy, locus of control, self-esteem, and self-control were evaluated, but overall, studies evaluating the association between psychological features and treatment outcome failed to report consistent results.<sup>17</sup> More frequent health coaching appointments might assist weight loss through enhanced education, monitoring, or self-evaluation and support positive changes in psychological factors.

Health coaching compliance (ie, completed appointments) may be related to changes in psychological factors. This was evident in a study examining weight loss in obese women that identified changes in body satisfaction; mood contributed to increased attendance at exercise sessions.<sup>18</sup> Factors that may pose a risk for weight regain include a history of weight cycling, disinhibited eating, binge eating, more hunger, eating in response to negative emotions and stress, and more passive reactions to problems. Setting clear program expectations with participants and frequent meetings with a health coach to provide regular accountability

and feedback may be useful in improving outcomes. Furthermore, health coach knowledge and use of skills such as motivational interviewing may support long-term behavior change through more frequent contact with participants. Skillful empathetic listening and nonjudgmental reflections allow health coaches to encourage clients to talk about change. By building rapport, coaches can create a nonjudgmental space for clients to resolve ambivalence about their health behaviors and take action.<sup>19</sup> Among adults seeking weight loss in primary care who were randomly assigned to a motivational interviewing condition, retention rates were high, with a majority of studies reporting retention rates between 80% and 100%.<sup>20</sup> This supportive environment may encourage clients to tolerate change longer, despite experiencing setbacks or failures when attempting change.

Total spending was tracked with meal replacements serving as a proxy for nutrition plan compliance. Greater spending (ie, nutrition plan compliance) was associated with more weight loss. An additional \$1000 USD in spending resulted in a weight loss of 2.96 kg or 2.89%. This result is consistent with previous studies.<sup>21,22</sup> For example, Bogers et al<sup>21</sup> examined the relationship between intervention costs and treatment effectiveness and reported a positive relationship between them. They concluded that an increase in costs of up to €55 (approximately \$64 USD) was associated with an extra weight reduction of 2.5%; increases between €110 to €165 (approximately \$128 to \$192 USD) were associated with an extra weight reduction of 0.7% and increases between €220 and €275 (approximately \$257 to \$321 USD) were associated with an extra weight reduction of 0.1%. Intervention costs may partly reflect the intensity of

a weight loss program, accounting for more health coaching sessions, additional personalized education, and structured nutrition programming that likely cost more, and ultimately, result in greater weight loss.

Others have raised the concern that whereas meal replacements have empirical support, the cost may be a potential barrier to certain people.<sup>23</sup> In this study, the daily cost of meal replacements averaged about \$6 USD per day with greater costs during the initial weight loss phase and less cost over time as participants transitioned to more grocery foods. Future research should evaluate and compare the total costs of eating meals at home and away from home at restaurants. Shopping more effectively and preparing more meals at home may impact total food spending, potentially offsetting the cost of meal replacements and intervention programming. Additionally, we did not evaluate any effects of changes in medication usage, dosage, or other health risks that may contribute to short- and long-term spending or savings.

In the current study, 92% of participants experienced clinically significant weight loss (lost and maintained > 5% of their initial weight) while the remaining 8% did not lose any weight or gained weight. Individual variations in response to the same intervention have been observed in other studies with some losing weight while others gain.<sup>24</sup> Individuals who lose weight frequently regain weight later, as was reported in a study in which more than half of participants who lost weight regained the weight within 2 years, and more than 80% of lost weight was regained at 5 years.<sup>25</sup> Weight maintenance and long-term outcomes are improved when ongoing support is provided. It is critical for programs targeting weight loss to include interactions with a healthcare provider or health coach for at least one year.<sup>2</sup> For the current study, our findings demonstrated improved outcomes were associated with increased health coaching appointments. Ongoing support through health coaching appointments could mitigate weight regain patterns over time because the health coach supports the client in achieving long-term goals that are aligned with personal values through focusing on behavior change and active learning processes. For these reasons, health and wellness coaching has been proposed as a promising strategy and effective approach for weight loss in short-term, long-term maintenance, and sustained health behavior change.<sup>26</sup>

Additionally, we examined the effect of early weight loss success on weight change over time. Participants who experienced successful weight loss in either the first month or first 2 months significantly reduced their weight more than those who did not. Whereas these results are consistent with other research, a common critique is that rapid weight loss may be less sustainable; however, several studies have shown that rapid weight loss does not affect weight regain and may reduce attrition.<sup>27-30</sup> In the Look AHEAD Trial, first-

and second-month weight loss was associated with 8-year weight loss.<sup>14</sup> Furthermore, participants with greater initial weight losses maintained substantially more weight loss over the 10-year follow-up period, highlighting the effectiveness of early weight loss as a potentially useful indicator of long-term success.<sup>23</sup> Other research indicated early increases in physical activity and early weight loss improved mood and were associated with greater self-efficacy, continued attendance, and compliance with health-related behaviors.<sup>14</sup> In practice, weight management programs should pursue methods to encourage and extend participant attendance, as early success with weight loss may lead to psychological improvements that support ongoing attendance and continued weight loss.<sup>31</sup>

Although weight loss is encouraged in the mitigation of chronic conditions, such as prevention of type 2 diabetes and is a mechanism through which type 2 diabetes reversal occurs,<sup>32</sup> there are some risks associated with weight loss. Weight-centered paradigms and thin-idealizations are associated with body dissatisfaction, disordered eating, weight cycling, and experienced weight stigma.<sup>33-37</sup> Given these associations, it is imperative that programs targeting overweight and obesity encourage healthy habits and behaviors and discourage unhealthy weight loss practices (such as severe restriction, purging, or using exercise as a compensatory behavior). The program in the current study provides a low calorie, nutrient-dense diet and health coaching that focuses on a number of healthy practices such as self-compassion, mindfulness, body image, and stress reduction. Furthermore, individuals were encouraged to eat when hungry and health coaches helped them identify nutrient-dense foods that could help alleviate hunger.

### Limitations and Strengths

The current study has several limitations. Many factors (confounders) may have affected the results of this study. For example, we were unable to control for quality of health coaching techniques potentially affecting attendance, medication compliance, participant behavior (eg, previous weight loss attempts) and seasonal impact on weight loss. Positive experiences with a health coach could have influenced participant motivation to schedule and attend future health coaching appointments. Furthermore, a noted barrier of weight loss and weight maintenance in adults enrolled in a weight management program is lack of rapport between client and health coach as a result of low confidence in the health coach's knowledge and abilities.<sup>38</sup> The current study is limited by not being able to account for health coach characteristics.

We were also unable to generalize the results of the study to men, as there were few men included in the study. Having identified this, the composition of the sample matches what is typical of adults enrolled in

behavioral weight management programs.<sup>39</sup> Weight regain is a common occurrence after weight loss.<sup>13,40</sup> A primary criticism of weight loss research is the lack of studies evaluating weight maintenance outcomes at longer follow-up assessments, such as 10 years. The current study could be improved by longitudinally assessing participant weight outcomes over the span of 10–20 years. These findings could help identify the rates of weight loss, weight regain, and other patterns and trends of weight change for adults enrolled in a commercial weight loss program. Finally, total spending was used as a proxy for consumption of meal replacements. Without reviewing food diaries or incorporating real-time data collection methods to determine meal plan adherence, it is not certain that participant spending on meal replacements means participants were compliant with the meal plan. Our study would have been improved if we were able to determine total number of meal replacements purchased by individuals within each of the 5 study groups and had incorporated a method such as ecological momentary assessment (EMA) to collect real-time data on compliance. Additionally, we did not collect data on possible confounding variables such as participant motivation. As such, we could not control for confounders when examining group differences in weight outcomes. Study strengths include a large sample size with longitudinal collection of body weight data, and statistical analysis using multivariable models, which allow for more robust estimation over time. A large sample size participating in a commercial program provides accurate mean values and might enhance the generalizability of the findings to “real-world” commercial weight loss programs.

## Conclusions

In the present study, we examined factors that influence the success of a behavioral weight loss program. We found that the number of completed monthly health coaching appointments and total spending by participants (an indicator of meal replacement compliance) were significant predictors of successful weight loss. In addition, participants who visited a health coach more frequently were more likely to maintain weight loss. Therefore, participants should be made aware of the benefits of these strategies to optimize weight loss goals. Also, results from this study may facilitate healthcare providers in their decisions to refer obese patients to programs that emphasize greater frequency of meetings and structured nutrition support.

## Human Subjects Statement

The University of Mississippi Institutional Review Board approved the study protocol for secondary data analysis as exempt/not human subject research (Protocol 19x-189). All participants are members of

the weight management program, and the data in this study were provided to the authors without any identifying information. Therefore, given the purpose of the study, informed consent was not obtained.

## Conflict of Interest Statement

Two authors are employed by the weight management program, one full-time and one part-time. Three authors were paid through a grant for statistical analysis.

## References

1. US Centers for Disease Control and Prevention. Adult Obesity Facts. <https://www.cdc.gov/obesity/data/adult.html>. Published June 29, 2020. Accessed October 22, 2020.
2. Jensen MD, Ryan DH, Apovian CM, et al. 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society [published correction appears in *Circulation*. 2014 Jun 24;129(25 Suppl 2):S139-40]. *J Am Coll Cardiol*. 2014;129(25 Suppl 2):S102-S138. <https://doi.org/10.1016/j.jacc.2013.11.004>
3. Elmer PJ, Obarzanek E, Vollmer WM, et al. Effects of comprehensive lifestyle modification on diet, weight, physical fitness, and blood pressure control: 18-month results of a randomized trial. *Ann Intern Med*. 2006;144(7):485-495. <https://doi.org/10.7326/0003-4819-144-7-200604040-00007>
4. Martin CB, Herrick KA, Sarafrazi N, Ogden CL. Attempts to Lose Weight Among Adults in the United States, 2013–2016. *NCHS Data Brief*. 2018;(313):1-8.
5. Centre for Public Health Excellence at NICE (UK); National Collaborating Centre for Primary Care (UK). *Obesity: The Prevention, Identification, Assessment and Management of Overweight and Obesity in Adults and Children*. London: National Institute for Health and Clinical Excellence (UK); December 2006.
6. Gudzone KA, Doshi RS, Mehta AK, et al. Efficacy of commercial weight-loss programs: an updated systematic review. *Ann Intern Med*. 2015;162(7):501-512. <https://doi.org/10.7326/M14-2238>
7. Tsai AG, Wadden TAJA. Systematic review: an evaluation of major commercial weight loss programs in the United States. *Ann Intern Med*. 2005;142(1):56-66. <https://doi.org/10.7326/0003-4819-142-1-200501040-00012>
8. Elfhag K, Rössner S. Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obes Rev*. 2005;6(1):67-85. <https://doi.org/10.1111/j.1467-789X.2005.00170.x>
9. Lindner H, Menzies D, Kelly J, et al. Coaching for behaviour change in chronic disease: a review of the literature and the implications for coaching as a self-management intervention. *Aust J Prim Health*. 2003;9(3):177-185. <https://doi.org/10.1071/PY03044>

10. Sherifali D, Viscardi V, Bai JW, Ali RM. Evaluating the Effect of a Diabetes Health Coach in Individuals with Type 2 Diabetes. *Can J Diabetes*. 2016;40(1):84-94. <https://doi.org/10.1016/j.cjcd.2015.10.006>
11. US Department of Health and Human Services and US Department of Agriculture. 2015–2020 *Dietary Guidelines for Americans*. 8th ed. <http://health.gov/dietaryguidelines/2015/guidelines/>. Published December 2015. Accessed July 29, 2020.
12. Look AHEAD Research Group. Eight-year weight losses with an intensive lifestyle intervention: the look AHEAD study. *Obesity (Silver Spring)*. 2014;22(1):5-13. <https://doi.org/10.1002/oby.20662>
13. Mann T, Tomiyama AJ, Westling E, et al. Medicare's search for effective obesity treatments: diets are not the answer. *Am Psychol*. 2007;62(3):220-233. <https://psycnet.apa.org/doi/10.1037/0003-066X.62.3.220>
14. Unick JL, Neiberg RH, Hogan PE, et al. Weight change in the first 2 months of a lifestyle intervention predicts weight changes 8 years later. *Obesity (Silver Spring)*. 2015;23(7):1353-1356. <https://dx.doi.org/10.1002/oby.21112>
15. Neymotin F, Nemzer LR. Locus of control and obesity. *Front Endocrinol (Lausanne)*. 2014; 5:159. <https://dx.doi.org/10.3389%2Ffendo.2014.00159>
16. Van der Merwe M. Psychological correlates of obesity in women. *Int J Obesity (Lond)*. 2007;31(Suppl 2):S14-S32. <https://doi.org/10.1038/sj.ijo.0803731>
17. Lazzaretti L, Rotella F, Pala L, Rotella CM. Assessment of psychological predictors of weight loss: How and what for?. *World J Psychiatry*. 2015;5(1):56-67. <https://doi.org/10.5498/wjpv.v5.i1.56>
18. Annesi JJ, Whitaker AC. Psychological factors associated with weight loss in obese and severely obese women in a behavioral physical activity intervention. *Health Educ Behav*. 2010;37(4):593-606. <https://doi.org/10.1177%2F1090198109331671>
19. Simmons LA, Wolever RQ. Integrative health coaching and motivational interviewing: synergistic approaches to behavior change in healthcare. *Glob Adv Health Med*. 2013;2(4):28-35. <https://doi.org/10.7453/gahmj.2013.037>
20. Barnes RD, Ivezaj V. A systematic review of motivational interviewing for weight loss among adults in primary care. *Obes Rev*. 2015;16(4):304-318. <https://doi.org/10.1111/obr.12264>
21. Bogers RP, Barte JC, Schipper CM, et al. Relationship between costs of lifestyle interventions and weight loss in overweight adults. *Obes Rev*. 2010;11(1):51-61. <https://doi.org/10.1111/j.1467-789X.2009.00606.x>
22. Finkelstein EA, Kruger E. Meta- and cost-effectiveness analysis of commercial weight loss strategies. *Obesity (Silver Spring)*. 2014;22(9):1942-1951. <https://doi.org/10.1002/oby.20824>
23. Salvia MG. The Look AHEAD Trial: Translating Lessons Learned Into Clinical Practice and Further Study. *Diabetes Spectr*. 2017;30(3):166-170. <https://doi.org/10.2337/ds17-0016>
24. Donnelly JE, Honas JJ, Smith BK, et al. Aerobic exercise alone results in clinically significant weight loss for men and women: midwest exercise trial 2. *Obesity (Silver Spring)*. 2013;21(3):E219-E228. <https://doi.org/10.1002/oby.20145>
25. Anderson JW, Konz EC, Frederich RC, Wood CL. Long-term weight-loss maintenance: a meta-analysis of US studies. *Am J Clin Nutr*. 2001;74(5):579-584. <https://doi.org/10.1093/ajcn/74.5.579>
26. Dayan PH, Sforzo G, Boisseau N, et al. A new clinical perspective: Treating obesity with nutritional coaching versus energy-restricted diets. *Nutrition*. 2019;60:147-151. <https://doi.org/10.1016/j.nut.2018.09.027>
27. Purcell K, Sumithran P, Prendergast LA, et al. The effect of rate of weight loss on long-term weight management: a randomised controlled trial. *Lancet Diabetes Endocrinol*. 2014;2(12):954-962. [https://doi.org/10.1016/S2213-8587\(14\)70200-1](https://doi.org/10.1016/S2213-8587(14)70200-1)
28. Vink RG, Roumans NJ, Arkenbosch LA, et al. The effect of rate of weight loss on long-term weight regain in adults with overweight and obesity. *Obesity (Silver Spring)*. 2016;24(2):321-327. <https://doi.org/10.1002/oby.21346>
29. Nackers LM, Ross KM, Perri MG. The association between rate of initial weight loss and long-term success in obesity treatment: does slow and steady win the race? *Int J Behav Med*. 2010; 17(3):161-167. <https://doi.org/10.1007/s12529-010-9092-y>
30. Astrup A, Rössner S. Lessons from obesity management programmes: greater initial weight loss improves long-term maintenance. *Obes Rev*. 2000;1(1):17-19. <https://doi.org/10.1046/j.1467-789x.2000.00004.x>
31. Thomas JG, Bond DS, Phelan S, et al. Weight-loss maintenance for 10 years in the National Weight Control Registry. *Am J Prev Med*. 2014;46(1):17-23. <https://doi.org/10.1016/j.amepre.2013.08.019>
32. Roglic G. WHO Global report on diabetes: a summary. *Int J Noncommun Dis*. 2016;1(1)3-8.
33. Stice E. Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychol Bull*. 2002;128(5):825-848. <https://doi.org/10.1037/0033-2909.128.5.825>
34. Neumark-Sztainer D, Wall M, Larson NI, et al. Dieting and disordered eating behaviors from adolescence to young adulthood: findings from a 10-year longitudinal study. *J Am Diet Assoc*. 2011;111(7):1004-1011. <https://doi.org/10.1016/j.jada.2011.04.012>
35. Aphramor L. Is a weight-centred health framework salutogenic? Some thoughts on unhinging certain dietary ideologies. *Soc Theory Health*. 2005;3(4):315-340. <https://doi.org/10.1057/palgrave.sth.8700059>
36. Bacon L, Aphramor L. Weight science: evaluating the evidence for a paradigm shift [published correction appears in *Nutr J*. 2011;10:69]. *Nutr J*. 2011;10:9. Published 2011 Jan 24. <https://doi.org/10.1186/1475-2891-10-9>
37. Lawrence SA, Abel EM, Stewart C, Dziuban C. Social work students' perceptions of obesity. *J Soc Work Educ*. 2019;38(3):377-391. <https://doi.org/10.1080/02615479.2018.1521794>
38. Kleine HD, McCormack LA, Drooger A, Meendering JR. Barriers to and facilitators of weight management in adults using a meal replacement program that includes health coaching. *J*

- Prim Care Community Health*. 2019; 10:2150132719851643. <https://doi.org/10.1177/2150132719851643>
39. Williams RL, Wood LG, Collins CE, et al. Effectiveness of weight loss interventions – is there a difference between men and women: a systematic review. *Obes Rev*. 2015;16(2):171-186. <https://doi.org/10.1111/obr.12241>
40. Miller WC. How effective are traditional dietary and exercise interventions for weight loss? *Med Sci Sports Exerc*. 1999;31(8):1129-1134.