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Weight loss history as a predictor of weight loss: results from Phase I of the weight loss maintenance trial

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Abstract

Past studies have suggested that weight loss history is associated with subsequent weight loss. However, questions remain whether method and amount of weight lost in previous attempts impacts current weight loss efforts. This study utilized data from the Weight Loss Maintenance Trial to examine the association between weight loss history and weight loss outcomes in a diverse sample of high-risk individuals. Multivariate regression analysis was conducted to determine which specific aspects of weight loss history predict change in weight during a 6-month weight loss intervention. Greater weight loss was predicted by fewer previous weight loss attempts with assistance ($p = 0.03$), absence of previous dietary/herbal weight loss supplement use ($p = 0.01$), and greater maximum weight loss in previous attempts ($p < 0.001$). Future interventions may benefit from assessment of weight loss history and tailoring of interventions based on past weight loss behaviors and outcomes.

Keywords

Weight loss history; Previous weight; Weight loss method; Behavioral; Lifestyle; Greatest weight loss

Introduction

Recent estimates indicate that 34.2 % of Americans are overweight and an additional 33.8 % of Americans are obese (Flegal et al., 2010). Overweight and obesity have serious individual and societal costs, as they contribute substantially to disease burden and mortality, increased medical care expenditure, and declines in worker productivity (Danaei et al., 2009; Guh et al., 2009; Hammond & Levine, 2010).

Lifestyle interventions for weight loss have been shown to produce significant weight reductions and improved health in overweight and obese individuals (Goodpaster et al., 2010; Knowler et al., 2002; Stevens et al., 2001; Wadden et al., 2012). However, even in highly successful weight loss programs a portion of individuals fail to achieve meaningful weight loss.

Identifying characteristics of individuals who respond poorly to weight loss efforts may aid in determining which individuals need more intensive or different treatments. There is evidence that individuals' past weight loss efforts may be an important predictor of future weight loss outcomes. Teixeira et al. (2005), in a review of the literature on predictors of weight loss, concluded that past participation in weight loss programs and past dieting attempts are associated with poorer subsequent weight loss outcomes. For example, in one study reviewed, more dieting episodes in the past year predicted poorer weight loss outcomes during a behavioral weight loss intervention in 158 overweight and obese individuals (Teixeira et al., 2004).

Though the majority of studies have found a deleterious association between more frequent past weight loss efforts and outcomes in a renewed weight loss attempt, other studies have failed to observe this relationship (Fabricatore et al., 2009; Pekkarinen et al., 1996). For

example, Fabricatore et al. (2009) examined the relationship between weight loss intervention outcomes and three specific aspects of weight loss history: (1) number of diets lasting fewer than 3 days in the past year, (2) number of diets lasting longer than 3 days in the past year, and (3) number of previous weight loss attempts resulting in a weight reduction of 10 lbs (4.5 kg) or more. They found no relationship between these variables and weight loss outcomes at 1 year follow-up.

Unfortunately, many past studies examining weight loss history have not assessed important details of past weight loss efforts that may affect the relationship with subsequent weight loss. It is possible that differing types of past dieting efforts, which can vary in their psychological or biological effects, may differentially affect weight loss outcomes in a new weight loss attempt. Furthermore, the amount of weight lost in past efforts may also be an important predictor of weight loss. Most studies conducted to date have either examined the presence of weight loss efforts resulting in a loss of 10 lbs (4.5 kg) or more, or the number of past weight loss attempts, regardless of weight loss outcomes. These variables may be differentially associated with weight loss outcomes and should both be evaluated.

Another emerging area of interest is the use of dietary and/or herbal supplements for weight loss promotion. Many individuals seek alternative lifestyle change strategies for losing weight, including the use of weight loss supplements. Estimates suggest that annual sales of dietary supplements exceed \$1.6 billion (Spano & Antonio, 2008). Although popular, few studies have examined the efficacy or safety of these supplements for weight loss (Dwyer et al., 2005; Lenz & Hamilton, 2004; Pittler & Ernst, 2004). A recent study by Pillitteri et al. (2008) found that approximately 34 % of adults who made a serious weight loss attempt reported using a dietary supplement. Supplement use was more common among women (44.9 %), those between the ages of 25–34 years, and those who had made more lifetime weight loss attempts. That is, dietary supplements are a popular choice despite a lack of rigorous evidence of their efficacy. Therefore, an examination of the use of over the counter weight loss supplements and weight loss outcomes is merited.

Finally, many past studies have been limited by the homogeneity of their sample with regards to race (Caucasian) and gender (female). Examination of the relationship between weight loss history and weight loss outcomes in different race and gender subgroups is warranted, as both weight loss outcomes (West et al., 2008) and the prevalence of certain weight loss behaviors (Blanck et al., 2007; Kruger et al., 2008) vary by gender and race.

The current study aimed to clarify past inconsistencies and provide a more detailed description of the associations between weight loss history and weight loss outcomes during an intensive lifestyle intervention. We utilized data from the Weight Loss Maintenance trial, a large multicenter clinical trial (Hollis et al., 2008; Svetkey et al., 2008). The Weight Loss Maintenance trial consisted of two phases. In Phase I, all participants entered a 6-month, group-based behavioral intervention. In Phase II, participants who achieved at least 4 kg of weight loss were randomized to one of three weight maintenance interventions. This study uses data from the weight loss phase (Phase I) only to test the hypothesis that weight loss history would be associated with weight loss in the current study.

Methods

Participants

Participants were 1,676 overweight or obese individuals enrolled in Phase I of the Weight Loss Maintenance trial. To be eligible for participation, participants had to be on medication treatment for hypertension and/or dyslipidemia, have a BMI of 25–45 kg/m², and be over 25 years in age. Participants were excluded if they were on medication for diabetes control, had

recently experienced a cardiac event, had received bariatric surgery, or had other psychiatric or medical conditions that would impair their ability to participate fully in the trial. Further details regarding the study sample can be found in Hollis et al. (2008).

Measures

Weight Loss History Questionnaire—The Weight Loss History Questionnaire is a newly developed 8-item measure of past weight loss efforts that assesses type of weight loss efforts and the degree of weight loss success (see “Appendix”). Participants were asked to report the following: (1) number of times intentional weight loss reached or exceeded 10 lbs, (2) number of weight loss attempts with assistance (dietitian, commercial program, etc.), (3) number of attempts without assistance, and (4) number of attempts using exercise. Response options for these items were never, 1–2 times, 3–5 times, 6–10 times, or greater than 10 times. A fifth question asked participants to separately indicate if they have ever utilized any of the following for weight loss purposes: prescription drugs, over the counter drugs, dietary/herbal supplements, or meal replacements. A final question asked participants to report how much weight they had lost during their most successful weight loss attempt, with the response options of 0–5, 6–10, 11–15, 16–20, 21–30, 31–40, 41–50, and greater than 50 lbs. Questions regarding past weight loss referred to pounds (lbs), since US participants have greater familiarity with that unit of measurement than with kilograms (kg). In the current paper, direct references to these questionnaires use “*pounds*” (lbs), to be consistent with the wording of the questionnaire. However, all clinic measurements of participants’ weight used kilograms (kg) as the unit of measure and are presented in kilograms (kg).

Weight change—Weight was measured twice at Phase I entry and twice at the completion of Phase I by trained research staff. If duplicate weights were discrepant, they were averaged to determine a final weight. Participants were measured on a high quality, calibrated digital scale wearing light clothes. Weight change was calculated by subtracting weight at the start of the intervention from weight at the end of Phase I; a negative value indicates loss, positive value, gain. Multiple imputation was used for missing weights (see “Statistical analyses”, below).

Procedure

The trial was conducted between August 2003 and June 2007 at four clinical sites (Baltimore, Baton Rouge, Durham, and Portland). This study was approved and monitored by all participating institutes’ Institutional Review Boards. Prior to the start of the intervention, participants completed the Weight Loss History Questionnaire and their height and weight were measured. The Phase I lifestyle intervention was primarily comprised of group sessions focused on enhancing motivation, identifying specific behavior change goals, and problem-solving. Group sessions were participant-centered and interactive, with 18–25 participants per group. Participants completed weekly group sessions lasting 90 min over a 6 month period. Lifestyle change goals included 180 min per week of moderate physical activity, following the Dietary Approaches to Stop Hypertension eating pattern (Appel et al., 1999), and maintaining daily food records. Additional study details can be found in Brantley et al. (2008) and at the study website: <http://www.wlmtrial.org>.

Statistical analyses

Descriptive data for baseline participant characteristics and weight history variables are presented as means and standard deviations for continuous variables, or as a percentage of the sample for noncontinuous variables. To determine the relationship between weight loss history and weight loss outcomes, weight loss history variables were regressed upon weight change in kilograms in a multiple regression analysis after controlling for race, gender, and

the interaction of race and gender. To assess for potential race and gender group differences, three way interactions between race, gender and weight loss history variables were also evaluated. Missing values of the final weight were replaced using multiple imputation (Collins et al., 2001; Schafer & Graham, 2002). The most parsimonious model was chosen using the model comparisons approach. The model comparisons approach tests for significance of the change in R^2 between a “full” model (e.g., all predictors) and a “reduced” model (any proper subset of the predictors). This procedure has been well described by Maxwell and Delaney (1990). We report combined estimates across the five imputations, with standard errors in tests adjusted to account for between imputation variance. See Svetkey et al. (2008), for additional details about use of multiple imputation statistical procedure.

Results

Participant characteristics

Participants were 44 % African American and 33 % male (Table 1). The average age of participants was 55 years, and the majority of participants had a post-high school education. The average baseline BMI was 34.3 kg/m², and 79 % of participants were in the obese weight range. The average weight loss in Phase I was -5.8 kg (5.4).

As reported in the Phase I weight loss paper by Hollis et al. (2008), end-of-Phase I weights were imputed on 132 (8 %) of the 1,685 participants who started Phase I; weights on two participants who died during Phase I were set to missing. Although 1,685 participants started Phase I, for this analysis, only 1,678 participants were included due to missing values from the Weight Loss History Questionnaire. Multiple imputation is used to avoid the biased estimates and test results that obtain in complete-data analysis (omitting dropouts), because there are commonly differences between those who complete all data and those who fail to do so. The imputation process for this analysis included an extensive set of variables, so analytic results should have little or no bias (an untestable assumption). Only 9 of the original 1,685 participants who started Phase I were excluded from the analysis, 7 because they were missing data on one or more covariates used in the analysis that were not part of the imputation process and 2 because they died during Phase I.

Participants' weight loss history characteristics are summarized in Table 2. Approximately two-thirds of participants reported 1–5 past attempts with assistance, attempts without assistance, attempts with exercise, and attempts resulting in greater than 10 lbs lost. Weight loss attempts with assistance were the least commonly reported past weight loss strategy. Approximately three-fourths of participants denied past use of prescription drugs, over the counter drugs, and dietary/herbal supplements for weight loss, while nearly half of participants reported past use of meal replacements. Participants' maximum past weight loss was widely distributed, with between 10 and 20 % of individuals endorsing a maximum loss of each of the following: 6–10 lbs, 11–15 lbs, 16–20 lbs, 21–30 lbs, and 31–40 lbs.

Predictors of weight loss

Parameter estimates for the final model are provided in Table 3. Race, Gender, and Race × Gender were significant covariates. As reported in the Phase I outcomes paper, African Americans lost less weight than Caucasians, women lost less weight than men, and African American women lost the least amount of weight (Hollis et al., 2008). The model contained three significant predictors from the Weight Loss History Questionnaire: (1) number of previous weight loss attempts with assistance (e.g., dietitian, commercial weight loss program), (2) prior use of dietary/herbal supplements for weight loss, and (3) maximum amount of weight lost in past attempt. Fewer previous weight loss attempts with assistance

(Fig. 1), no past use of supplements, and a history of higher maximum weight lost were associated with greater current weight loss (See Fig. 2). Number of previous weight loss attempts without assistance, number of times 10 lbs or more have been lost, number of attempts using exercise, past use of weight loss drugs, and past use of meal replacements did not emerge as significant predictors of weight loss. No significant interaction effects were found for weight loss history variables and gender, race, or the gender-by-race interaction.

Discussion

Utilizing data collected from a large, diverse sample of overweight and obese individuals, we identified three weight history characteristics that were predictive of greater weight loss: fewer previous weight loss attempts utilizing assistance (e.g., dietitian, commercial weight loss program); the absence of a history of dietary/herbal supplement use; and higher maximum weight loss during previous intentional weight loss efforts. These findings resolve some of the inconsistencies in the literature and provide a more nuanced description of the effects of past weight loss efforts on renewed weight loss attempts. Although the parameter estimates for the significant predictors were modest in magnitude (e.g., actual amount of weight lost), the findings suggest an important clinical feature found in many controlled weight loss clinical trials (Ali et al., 2012; Knowler et al., 2002). Specifically, modest weight loss can result in clinically meaningful improvements in blood pressure, cholesterol, and reductions in diabetes incidence. This suggests that even if only a small amount of weight is lost or sustained, the impact of this weight loss on metabolic measures of health can be beneficial.

The relationship between the number of previous assisted weight loss attempts and poorer weight loss outcomes suggests that there may be a point of diminishing returns for individuals who seek professional help. Those who entered the Weight Loss Maintenance trial with no previous experience of professional weight loss help, may have obtained new information, learned new skills and received group support for the first time. Whereas for those with previous experience in intense behavioral weight loss programs, the information provided in the Weight Loss Maintenance program may have been familiar or already learned. Additionally, individuals who participate in repeated weight loss programs may have characteristics that differ from the general overweight population; a difference that may develop over multiple attempts and predict less successful weight loss, i.e., physiological resistance (Leibel & Hirsch, 1984), or trait differences that may put them at greater risk for suboptimal outcomes (e.g., personality vulnerabilities). Potentially, a history of unsuccessful weight loss and weight loss maintenance efforts has led to repeatedly seeking assistance for weight loss.

Individuals who tried dietary or herbal supplements in the past also experienced more difficulty losing weight during the current weight loss trial. Past supplement use may be a marker of more intensive, or extreme, efforts to lose weight, and thus of those individuals who are more resistant than average to weight loss. Since supplements have proved to have limited effects on weight loss (Egger et al., 1999), individuals who use supplements may become discouraged at their poor weight loss outcome, contributing to decreased self-efficacy. Though the literature is mixed, some studies have shown that greater self-efficacy is associated with more success in weight loss (Linde et al., 2006; Smith et al., 1995). Thus, past use of ineffective weight loss strategies may contribute to worse future outcomes via reduction in self-efficacy. An additional possibility is that individuals with a history of supplement use may have expectations of more rapid weight loss. Given that the intervention program in the Weight Loss Maintenance trial focused on slow and sustainable weight loss, these individuals may not have maximized outcomes due to a mismatch between their expectations and the goals of the program. Addressing participants' treatment

expectations may therefore increase their odds of weight loss success (Brown & Wimpenny, 2011). Additionally, the level to which recurrent use of weight loss supplements impacts later physiology is unknown.

Our results indicate that those individuals who have successfully lost larger amounts of weight in the past were more likely to lose weight again in the Weight Loss Maintenance trial. Whereas multiple past studies have shown either a detrimental effect (Kiernan et al., 1998; Teixeira et al., 2002; Teixeira et al., 2005) or no effect (Fabricatore et al., 2009; Teixeira et al., 2005) of past weight loss on subsequent weight, many of these studies have specifically been assessing the frequency of relatively small weight losses, i.e. 10 lbs (4.5 kg). Consistent with this literature, in the current study the frequency of weight losses of “10 lbs or more” was not related to subsequent weight loss. However, maximal past weight loss was associated with greater current weight loss. These results may be explained by the fact that individuals who have successfully lost a substantial amount of weight in the past may have higher levels of confidence and self-efficacy with regards to their ability to lose weight again in the future. This is consistent with findings of the important relationship between self-efficacy and weight loss (Teixeira et al., 2005). A second class of explanations may be that these individuals have genetic and/or physiological characteristics contributing to more substantial weight loss but, further research is needed in this area.

Race and gender differences in the amount of weight lost during clinical trials have been reported, warranting an examination of the relationship between weight loss history and weight loss outcomes across race and gender groups. However, previous studies had been limited in their ability to examine this relationship. The results of the current study indicate that although the race-gender subgroups differed in mean weight loss in our sample, the relationship between weight loss history and subsequent weight loss did not differ according to gender or race.

This study has a number of limitations. First, weight loss history variables were measured utilizing a non-validated questionnaire developed specifically for this study. Additionally, this questionnaire relies on retrospective self-report for participants’ weight loss history, and that may be subject to bias. In the current study, we were able to examine differences between African Americans and non-African Americans, but we were not able to study other ethnic groups. Future research to investigate these relationships in other ethnic groups is needed. Finally, it should be noted that this study is limited in its ability to draw conclusions about causality.

The results of this study suggest that personalized or tailored weight loss interventions based on weight loss history may be warranted. For example, individuals who have a history of losing a large amount of weight may require less intensive weight loss interventions; whereas they may benefit from greater focus on weight maintenance. For individuals who have a history of numerous past weight loss efforts, particularly using dietary/herbal supplements or seeking assistance through a commercial program or with a dietitian, they may respond better to more intensive behavioral weight loss treatments or treatments with a more extensive focus on weight loss expectations or beliefs. Alternatively, more consideration may need to be given to alternative weight loss approaches, such as use of weight loss medication or bariatric surgery. More research is needed to determine if tailoring weight loss interventions on the basis of weight loss history is effective.

Conclusion

In conclusion, this study identified two specific past weight loss behaviors, the past use of dietary/herbal supplements and higher frequency of seeking professional assistance for

weight loss, that predict less weight loss during an intensive lifestyle intervention. Whereas these past weight loss attempts were associated with lesser weight loss, higher maximum weight loss during a past weight loss attempt was associated with greater weight loss in the current study. Notably, these relationships did not differ across race and gender subcategories. Further research is needed to identify the mechanism responsible for these associations. Identification of individuals at risk for poor weight loss due to past weight loss behavior may help improve outcomes in future weight loss interventions.

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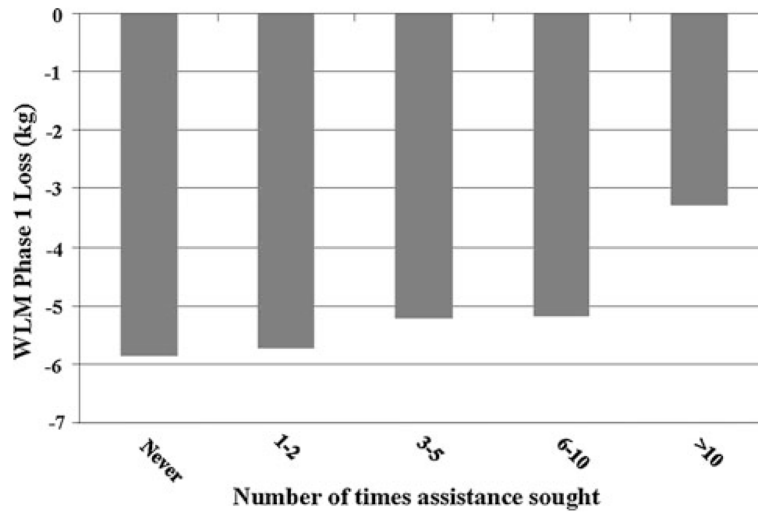


Fig. 1. Amount of weight loss in WLM according to past number of times participant sought assistance for weight loss

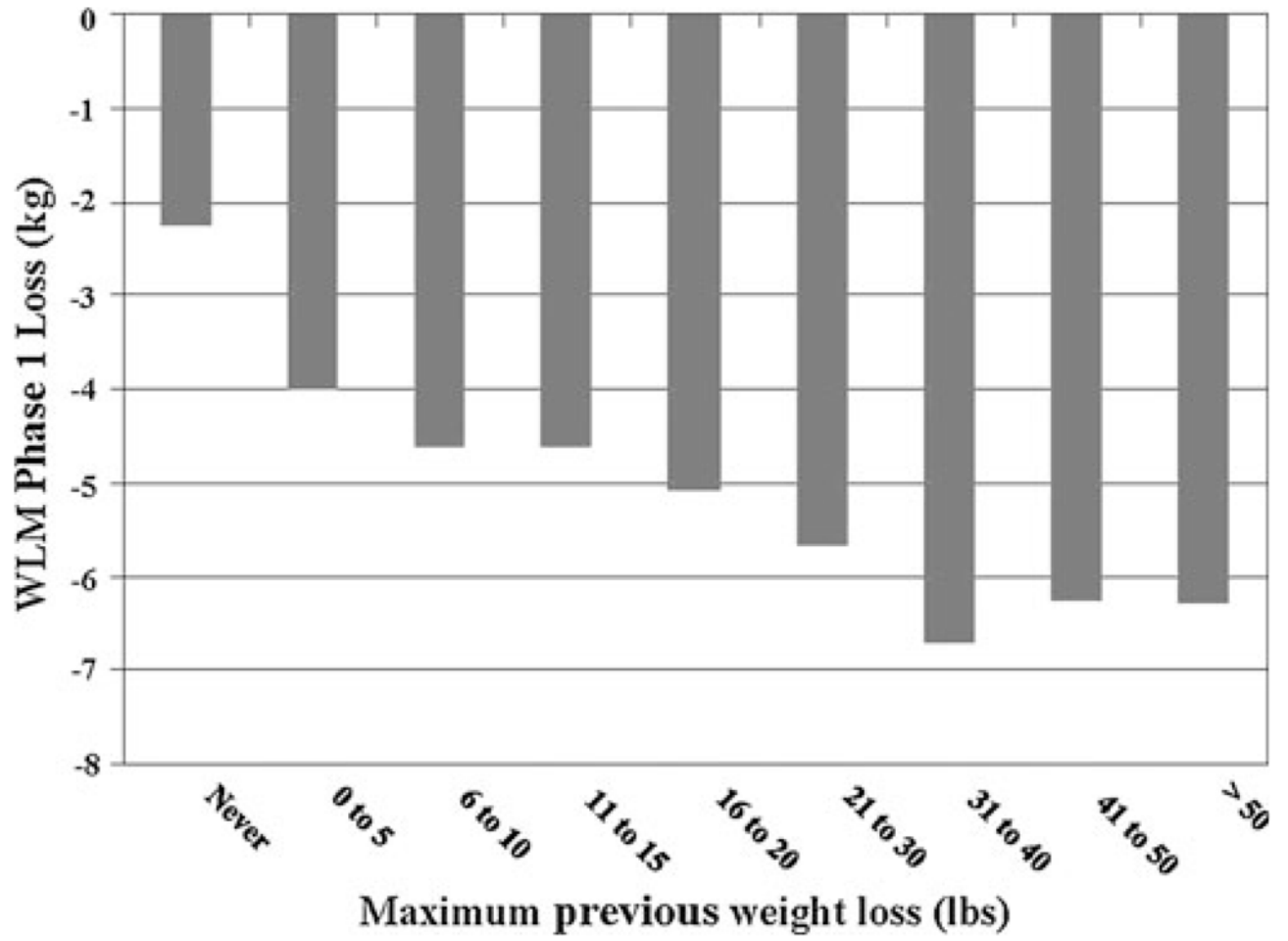


Fig. 2. Amount of weight loss in WLM according to past maximum weight loss

Table 1

Characteristics of study participants at phase I entry

	Total	African American		Non-African American	
		Men	Women	Men	Women
N	1676	195	535	353	593
Age, year (SD)	54.7 (9.1)	52.2 (10.1)	52.2 (8.9)	57.5 (8.9)	56.2 (8.1)
Women, %	67.3				
Education					
High school	9.0	6.7	7.5	5.8	13.2
Some college	33.7	29.7	39.7	23.2	35.8
College degree	22.2	29.7	21.9	22.5	19.8
Post college	35.1	33.8	30.9	48.5	31.3
Income, %					
<\$30,000	9.4	4.6	16.2	3.7	8.1
\$30,000–60,000	35.1	27.5	41.8	24.5	37.8
>\$60,000	55.5	67.9	42.0	71.8	54.0
On BP medications, %	87.5	89.2	94.6	82.2	83.8
On lipid-lowering medications, %	38.4	38.5	23.2	54.4	42.5
Weight, kg (SD)	96.4 (16.5)	107.1 (16.1)	95.1 (15.1)	104.7 (15.3)	89.2 (14.5)
BMI (SD)	34.3 (4.8)	34.0 (4.4)	35.6 (4.9)	33.6 (4.4)	33.6 (4.9)
Obese (BMI >30 kg/m ²), %	78.8	80.5	84.5	78.2	73.4

BP blood pressure, *BMI*/body mass index

Table 2

Weight loss history characteristics

	<u>Number of past weight loss attempts</u>					
	Never	1-2 Times	3-5 Times	6-10 Times	>10 Times	>10 Times
Past attempts with >10 lbs lost, %	10.6	30.6	33.5	14.2	11.2	11.2
Attempts with assistance, %	31.8	33.7	24.5	7.5	2.6	2.6
Attempts without assistance, %	9.5	30.2	30.9	14.4	15.0	15.0
Attempts using exercise, %	8.1	38.3	32.4	12.6	8.6	8.6

	<u>Number of times using specific strategies</u>	
	Never	Used 1 or more times
Prescription drugs, %	73.7	26.3
OTC drugs, %	76.9	23.1
Dietary/herbal supplements, %	75.1	24.9
Meal replacements, %	53.3	46.7
No other method, %	61.3	38.7

	<u>Maximum previous intentional weight loss</u>								
	Never tried	0-5 lbs	6-10 lbs	11-15 lbs	16-20 lbs	21-30 lbs	31-40 lbs	41-50 lbs	>50 lbs
% endorsing weight loss	2.56	7.04	13.83	14.55	16.40	19.26	11.63	7.22	7.51

OTC over the counter

Table 3

Final model for dependent variable weight change (n = 1,676)

Effect	Parameter estimate ^a	Standard error	p value
Intercept (reference value, all measures)	-2.51	0.87	<0.0001
Race (non-AA = 1)	-1.34	0.31	<0.0001
Sex (male = 1)	-1.18	0.46	0.0111
Race × sex	-1.40	0.55	0.0115
Number of previous weight loss attempts with assistance			0.0258
Never	-2.56	0.84	
1–2	-2.43	0.82	
3–5	-1.90	0.82	
6–10	-1.88	0.91	
More than 10 (reference level)	0	–	
Supplement use (no past use = 1)	-0.83	0.30	0.0058
Amount of weight loss in previous attempts			<0.0001
Never tried to lose weight before	4.03	0.96	
0–5 lb	2.29	0.72	
6–10 lb	1.68	0.62	
11–15 lb	1.66	0.60	
16–20 lb	1.19	0.58	
21–30 lb	0.61	0.58	
31–40 lb	-0.42	0.65	
41–50 lb	0.03	0.67	
More than 50 lb (reference level)	0	–	

^aParameter estimate indicates the mean weight change at that value of the measure relative to the intercept (i.e., when all other measures are set at the reference value), add to intercept to obtain total estimated weight change. A negative parameter estimate indicates that the value of the measure is associated with less weight loss relative to the reference level

Appendix

Weight Loss History Questionnaire

The questions on this form ask about your history of weight loss. Please answer each question.

1. How many times in the past have you lost 10 pounds or more?
- never
 - 1-2
 - 3-5
 - 6-10
 - more than 10

2. If you have tried to lose weight before, how much did you lose in your most successful attempt?
- 0 to 5 pounds
 - 6 to 10 pounds
 - 11 to 15 pounds
 - 16 to 20 pounds
 - 21 to 30 pounds
 - 31 to 40 pounds
 - 41 to 50 pounds
 - more than 50 pounds
 - never tried to lose weight before

3. How many times in the past did you seek assistance to lose weight (e.g., commercial diet program or help from a dietitian)?
- never
 - 1-2
 - 3-5
 - 6-10
 - more than 10

4. How many times in the past did you try to lose weight without assistance?
- never
 - 1-2
 - 3-5
 - 6-10
 - more than 10

5. How many times in the past did you try to lose weight by getting more exercise (e.g., walking, running, biking)?
- never
 - 1-2
 - 3-5
 - 6-10
 - more than 10

6. Have you ever used any of the following to lose weight?.....
(Check all that you have tried)
- Prescription drugs (prescribed by your doctor)
 - Over the counter drugs (that is, not requiring a prescription)
 - Dietary or herbal supplements (such as Metabolife)
 - Meal replacements (such as slim fast, opti fast or other liquid or powdered meals)
 - Have not used these methods

7. The first phase of the WLM study includes a 20-week- long weight loss program. Realistically, how much weight do you estimate you would lose in that program? ___ lbs

8. What do you think would be the best weight for you? ___ lbs