Published in final edited form as:

Behav Res Ther. 2009 August ; 47(8): 685–691. doi:10.1016/j.brat.2009.05.004.

Predictors of Attrition and Weight Loss Success: Results from a Randomized Controlled Trial

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Abstract

Attrition is a common problem in weight loss trials. The present analysis examined several baseline and early-treatment process variables, as predictors of attrition and outcome in a clinical trial that combined pharmacotherapy and behavior therapy for weight loss. Participants were 224 obese adults who were treated with sibutramine alone, lifestyle modification alone, combined therapy, or sibutramine plus brief lifestyle modification. Predictors included baseline characteristics (e.g., demographic, weight-related, psychological, and consumption-related variables), plus attendance, adherence, and weight loss in the early weeks of treatment. Outcomes were attrition and weight loss success (i.e., $\geq 5\%$ reduction in body weight) at 1 year. Multivariable models, adjusting for other relevant variables, found that younger age and greater baseline depressive symptoms were related to increased odds of attrition ($ps \leq .003$). Greater early weight loss marginally reduced the odds of attrition ($p = .06$). Predictors of weight loss success at 1 year were Caucasian ethnicity ($p = .04$), lower baseline depressive symptoms ($p = .04$), and weight loss during the first 3 weeks of treatment ($p < .001$). Thus, depressive symptoms at baseline were a significant predictor of both attrition and weight loss success. As a process variable, early weight loss appears to have more predictive value than early attendance at treatment sessions or early adherence.

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Disclosure: This analysis was funded in part by a research grant from Merck & Co., Inc. to Dr. Fabricatore. Additional support came from NIH grants K23 DK070777 to Dr. Fabricatore, and R01 DK56124 and K24 DK065018 to Dr. Wadden. Fabricatore has served as a consultant to Pfizer and Merck & Co., Inc, and has received research support from Merck & Co., Inc. Wadden has received research support from Merck & Co., Inc and from Abbott Laboratories. (The latter company manufactures sibutramine and provided the medication used in this study.) Heymsfield and Nguyen are employed by Merck & Co., Inc. The other authors have no potential conflicts to declare.

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Keywords

obesity; weight loss; attrition; lifestyle modification; pharmacotherapy

Introduction

Obesity researchers have made multiple attempts to identify participants' baseline characteristics that may predict their level of participation both in controlled trials (Teixeira et al., 2004) and clinic-based weight loss programs (Honas, Early, Frederickson, & O'Brien, 2003). Several characteristics predicted attrition in one or more studies, but none has emerged as a reliable prognosticator of program completion (Wadden & Letizia, 1992). Younger age appears to be the most consistent demographic predictor of attrition (Honas et al., 2003; Dalle Grave et al., 2004, 2005; Clark, Niaura, King, & Pera, 1996). Gender may also play a role; females had greater odds of attrition in at least one study (Honas et al., 2003), but sex was a constant or was not examined as a predictor of attrition in several others (e.g. Teixeira et al. 2004; Dalle Grave et al., 2004, 2005). Greater stress (Yass-Reed, Barry, & Dacey, 1993), depressive symptoms (Teixeira et al. 2004; Clark et al., 1996; Anton et al., 2008), and weight loss expectations (Teixeira et al. 2004; Dalle Grave et al., 2004, 2005; Jones, Harris, Waller, & Coggins, 2005) are psychosocial factors that have received some empirical support for their role in predicting attrition. In interviews with noncompleters, Grossi et al. (2006) found that most attributed their attrition to "practical problems," including problems at work or home, or a difficult commute to the treatment center.

A volume of related research has attempted to discover pretreatment variables that predict weight loss in a structured program. In a comprehensive review, Teixeira, Goings, Sardinha, and Lohman (2005) concluded that, while fewer previous weight loss attempts portended success, most baseline psychosocial and eating-related variables were not predictive of weight loss (e.g., mood, binge eating, disinhibited or restrained eating) or had not been sufficiently studied (e.g., body image, self-esteem, weight-related quality of life).

The present analysis sought to expand the pool of variables tested as predictors of attrition and weight loss success. In addition to baseline predictors, we examined early-treatment process variables. Previous research has found that one such process variable – early weight loss – consistently is related to longer-term outcomes (Craighead, Stunkard, & O'Brien, 1981; Dubbert & Wilson, 1984; Finer, Ryan, Renz, & Hewkin, 2006; Wadden et al., 1992). In addition, attendance at treatment sessions and completion of food records during treatment are associated with the outcomes of behavioral interventions (Baker & Kirschenbaum, 1993; Jefferey et al, 1984; Hollis et al., 2008; Wadden et al., 1997; Wing et al., 2004; Wadden et al, 2009). Thus, we expected that early-treatment process variables (including weight loss, visit attendance, and food record completion in the first 3 weeks of treatment) would be stronger independent predictors of attrition and 1-year weight loss than would any baseline characteristic.

Methods

Participants

Participants were 224 individuals who participated in a 52-week randomized controlled trial that combined pharmacotherapy and behavior therapy for weight loss (Wadden et al., 2005). We certify that all applicable institutional and governmental regulations concerning the ethical use of human volunteers were followed during this research, which was approved by the institutional review board of the University of Pennsylvania.

Procedures

As part of the screening process for the randomized controlled trial, participants completed the Weight and Lifestyle Inventory (WALI; Wadden & Foster, 2006) and the Beck Depression Inventory, Second Edition (BDI-II; Beck, Steer, & Brown, 1996). The WALI is a self-report instrument that assesses demographic characteristics, weight and weight loss history, eating behaviors, and many psychosocial variables. The WALI was the source of nearly all predictor variables in the present study. The instrument's reliability and validity have been reported previously; test-retest reliability coefficients and agreement rates (for dichotomous variables) were $\geq .86$ and $\geq .76$, respectively, for the items used in this study (Crerand et al., 2006; Wadden et al., 2006). The BDI-II is a 21-item self-report measure with good psychometric properties (Dozois, Dobson, & Ahnberg, 1998) that assesses symptoms of depression on a 0-to-3 scale. Item scores are summed, with total scores of 0-13, 14-19, 20-28, and ≥ 29 suggesting minimal, mild, moderate, and severe symptoms of depression, respectively (Beck et al., 1996).

Treatment Conditions

The trial's four treatment arms have been described in detail elsewhere (Wadden et al., 2005) and are only briefly summarized here. Participants in the sibutramine alone group ($n = 55$) had eight visits of 10-15 minutes with a primary care provider, received a pamphlet that provided tips for healthy eating and activity, and were prescribed 15 mg/day of sibutramine (Abbott Laboratories, Inc.). A second group ($n = 55$) received lifestyle modification alone (i.e., 30 group behavior modification sessions over 52 weeks). Participants in the combined therapy group ($n = 60$) received both the sibutramine and lifestyle modification treatments described above. The fourth group received sibutramine plus brief therapy ($n = 54$), which combined 15 mg/day of sibutramine with an abbreviated version of behavioral weight loss counseling (i.e., delivered by the primary care physician in eight 10-15 minute visits).

Predictor Variables

Treatment group was examined in relation to all other predictor variables, and as a predictor of both attrition and weight loss. Other predictors are listed below by category.

Demographics—Age, gender, ethnicity, marital status, and education were the demographic variables of primary interest. Ethnicity and marital status were dichotomized (Caucasian vs. Other and Married vs. Other, respectively). Education was categorized as: high school or less; some college; completed college; and graduate degree. Additional demographic variables were related to participants' addresses. Distance (in miles) and travel time (in minutes) to the study site were estimated using the “directions” tool on a popular mapping website (i.e., www.mapquest.com).

Weight status and history—Initial BMI was calculated from measured weight and height at baseline. Participants reported the age at which they first became overweight by ≥ 10 lb, from which we calculated years since onset of overweight. Weight loss history was assessed as the number of short diets (i.e., lasting ≤ 3 days) and long diets (i.e., lasting > 3 days) that participants reported beginning in the year prior to treatment, and the number of previous weight loss attempts (ever) that resulted in a reduction of ≥ 10 lb. Participants also reported how their weight changed in the 6 months prior to treatment (i.e., lost > 10 lb, lost 5-10 lb, remained stable, gained 5-10 lb, or gained > 10 lb). Participants who lost weight or remained stable were collapsed into one group, whereas those who reported having gained 5-10 lb and > 10 lb comprised separate groups. Finally, we used participants' desired weight loss (reported in pounds) to calculate weight loss goal as the percentage of initial body weight that the desired loss represented.

Psychological variables—Total BDI-II score served as a measure of depressive symptoms. Participants also reported (on single yes/no WALI items), whether they had ever experienced any emotional disturbance that disrupted their functioning or had received any mental health treatment. Three single items, each scored on a five-point scale, were used to assess self-esteem, current perceived stress, and anticipated stress in the upcoming 6 months, respectively. Responses were categorized to form groups that were as balanced and/or conceptually distinct as possible.

Intake behavior—The WALI contains two yes/no items taken from the Questionnaire on Eating and Weight Patterns, Revised (Yanovski, 1993). Based on responses to those questions, binge eating behavior was categorized as one of the following: no binge eating behavior; objective overeating (i.e., consumption of abnormally large amounts without subjective loss of control); subjective bingeing (i.e., loss of control without consuming abnormally large amounts); and objective bingeing (i.e., objective overeating with loss of control). Other intake variables examined alcohol intake (dichotomized as 0 vs. ≥ 1 per week), and smoking status (measured categorically as never, former, or current).

Process variables—Weight loss at week 3 was measured continuously and expressed as percent reduction in initial body weight. Attendance was expressed as the percentage of scheduled treatment visits patients had completed by week 3. (Participants in the sibutramine alone and sibutramine plus brief therapy groups each had two scheduled visits by week 3; those in the lifestyle modification alone and combined therapy groups had three.) Adherence was defined as the number of days on which participants (in the lifestyle modification alone, combined therapy, and sibutramine plus brief therapy groups) recorded their food intake, as instructed. (Participants in the sibutramine alone group were not instructed to keep food records and, thus, did not contribute adherence data.)

Outcome Variables

Attrition was defined as failure to complete the week 52 assessment visit. Weight loss success was defined as a reduction of $\geq 5\%$ from initial weight at the week 52 assessment. For those who did not complete that assessment, the determination was made using a modification of the last-observation-carried-forward (LOCF) procedure, in which 0.3 kg was added to the last measured weight for each month absent. This imputation method incorporates the rate of regain that is expected after discontinuation of a weight loss effort and has been used previously, including in the main report of this randomized controlled trial (Wadden, Berkowitz, Sarwer, Prus-Wisniewski, & Steinberg, 2001; Wadden et al., 2005; Wing, Tate, Gorin, Raynor, & Fava, 2006; Gorin et al, 2007; Sacks et al 2009).

Statistical Analyses

Descriptive statistics for the potential predictors are presented as mean (standard deviation) for continuous variables and as frequencies (percentages) for categorical variables. All predictor variables were assessed for significant differences based on treatment group, using analyses of variance (ANOVAs) for continuous variables and cross-tabulations with chi-square tests for categorical variables. When there were no differences between groups, data from all treatment groups were collapsed. Relationships between each predictor and outcome were initially tested using univariable logistic regressions. When treatment groups differed significantly on a predictor variable, these analyses were conducted separately for each treatment group.

Predictors found to be significantly ($p < .05$) or marginally ($p < .10$) associated with an outcome in the univariable analyses described above were simultaneously entered into a multivariable model to predict that outcome. Multicollinearity among predictors was assessed using tolerance

and the variance inflation factor (VIF). When these values were unacceptable (i.e., tolerance $< .20$ and $VIF \geq 5$), only one of the related predictors (i.e., that with the strongest univariate relationship to the outcome) was entered in the multivariable model. Odds ratios and 95% confidence intervals are presented for both the univariable and multivariable logistic regression models. Tests with $\alpha < 0.05$ and a confidence interval not containing the value of 1.00 were considered significant for the multivariable analyses.

Results

Attrition at 1 year was 17.4%, and weight loss success was achieved by 52.2% of participants. Descriptive statistics for all predictor variables are included in Table 1. The only predictor variables that differed significantly by treatment group were two process variables: attendance and weight loss in the first 3 weeks of treatment ($ps \leq .004$). Post hoc comparisons showed that participants in the sibutramine plus brief therapy group completed a greater percentage of their early visits (99.1 [6.8]%) than did those in the lifestyle modification alone (90.3 [17.8]%) and combined therapy (91.1 [17.2]%) groups. Participants in the sibutramine alone group (96.3 [13.1]%) did not differ from any of the other groups on early attendance. With respect to early weight loss, only the difference between participants in the combined therapy and sibutramine alone groups was significant (2.9 [1.5]% vs. 1.9 [1.6]% reductions in initial weight, respectively).

Univariable Models

The summary of univariable (i.e., no adjustment for additional variables) logistic regression results is shown in Table 2.

Predictors of attrition—Older age was related to less attrition, such that each additional year was associated with a 5% reduction in the odds of attrition. Similarly, each year since the onset of overweight was associated with a 5% reduction in the odds of attrition. (Age and years overweight were correlated at $r = 0.56$, $p < 0.001$.)

Education also was significantly related to attrition. Compared with those who had a high school education or less, those with some college and those who graduated college were significantly less likely to drop out. There was no significant reduction in attrition for those with a graduate or professional degree, compared to those with a high school education or less.

Self-esteem was related to attrition such that the odds of attrition were significantly higher for those who reported negative feelings about themselves than those with positive feelings. Furthermore, increasing symptoms of depression were related to attrition. Each additional point on the BDI-II increased the odds of attrition by 7%.

Among the process variables examined, attendance and weight loss at week 3 were significantly ($p = 0.02$) and marginally ($p = 0.09$) associated with attrition at 1 year, respectively. Results were then examined in each treatment group separately (because groups differed significantly in early attendance and weight loss). Attendance at week 3 was a significant predictor of attrition for participants in the lifestyle modification alone group (OR: 0.01, 95% CI: 0.00 – 0.48, $p = 0.02$), suggesting that each unit increase in the percentage of visits attended at week 3 reduced the odds of attrition by 99% for those participants. (Note that the mean early attendance in that group was 90%.) Weight loss at week 3 was a significant predictor of attrition only for participants in the sibutramine alone group (OR: 0.56, 95% CI: 0.32 – 0.94, $p = 0.03$). In these participants, each additional percentage of initial body weight that a participant lost at that time was related to a 45% reduction in the odds of attrition.

Predictors of weight loss success—Treatment group was related to weight loss success. Compared with participants in the sibutramine alone group, those who received combined therapy were significantly more likely to lose $\geq 5\%$ of initial weight. Neither the lifestyle modification alone group, nor the sibutramine plus brief therapy group had significantly greater odds of weight loss success compared with sibutramine alone.

Compared with Caucasians, persons of other ethnicities were significantly less likely to achieve at least a 5% weight loss at 1 year. Distance to the clinic was marginally related to success; each additional mile between the participant's home and the treatment site was associated with a 3% increase in the odds of success. Persons who had been overweight for more years had greater odds of losing $\geq 5\%$ of initial weight. Age, however, did not predict weight loss success.

Baseline depressive symptoms were marginally related to weight loss success. Each additional point on the BDI-II reduced the odds of success by 4%.

Early adherence (i.e., completion of food records) and weight loss predicted weight loss success at 1 year. Each additional day of food recording during the first three weeks of treatment was associated with a 7% increase in the odds of attaining at least a 5% weight loss at 1 year. (Note that this analysis did not include participants in the sibutramine only group, because they were not instructed to keep food records.)

In the full sample, each additional percent reduction from baseline weight at week 3 was related to an 89% increase in the odds of weight loss success. However, because early weight loss differed significantly among treatment groups, the relationship between weight loss at week 3 and success at 1 year was examined in each treatment group separately. The relationship was statistically significant in the sibutramine only (OR: 1.53, 95% CI: 1.03 – 2.28, $p = 0.04$), sibutramine plus brief therapy (OR: 2.68, 95% CI: 1.45 – 4.95, $p = 0.002$), and combined therapy (OR: 2.27, 95% CI: 1.36 – 3.80, $p = 0.002$) groups, suggesting 53% to 168% increased odds of weight loss success with each additional percent reduction in initial weight by week 3. The relationship between early weight loss and success at 1 year was marginally significant for participants in the lifestyle modification alone group (OR: 1.43, 95% CI: 0.96 – 2.13, $p = 0.08$).

We repeated all analyses with weight loss success determined using the baseline carried forward (BLCF) procedure for participants who dropped out of the study. There were no substantive differences from the results presented above.

Multivariable Models

As described above, all predictors that were marginally or significantly related to outcomes in univariable analyses were simultaneously entered into multivariable logistic regression models. Thus, the model to predict attrition tested age, educational attainment, years overweight, BDI-II score, self-esteem, attendance during the first 3 weeks of treatment, and weight loss after 3 weeks of treatment. (Although age and years overweight were correlated, the associated tolerance and VIF of 0.59 and 1.69, respectively, suggest sufficient independence of these variables to enter them in the same model.) Treatment group also was entered into this model because it was significantly related to one of the predictors (i.e., weight loss at 3 weeks). As shown in Table 3, only age and depressive symptoms emerged as significant predictors of attrition. Early weight loss was marginally related to attrition in this multivariable model.

Two multivariable analyses were conducted to predict weight loss success. The first examined treatment group, ethnicity, distance to the clinic, years overweight, BDI-II score, and weight loss at week 3. (Travel time was not included in this model due to its multicollinearity with

distance to the clinic [tolerance = 0.07, variance inflation factor = 15.07].) As shown in Table 4, treatment group was marginally related to success; however, those in the combined therapy group were significantly more likely than those in the sibutramine alone group to achieve at least a 5% reduction in initial weight. The increase in the odds of success with lifestyle modification alone versus sibutramine alone approached significance ($p = 0.09$). Ethnicity, depressive symptoms, and weight loss at week 3 were significant predictors of weight loss success in this multivariable model.

A second model to predict weight loss success was similar to the first, but also included food records completed during the first 3 weeks of treatment. Only participants in the sibutramine plus brief therapy, combined therapy, and lifestyle modification alone groups (i.e., the groups that were required to keep food records) were analyzed. In this model, shown in Table 5, depressive symptoms and initial weight loss became stronger predictors of weight loss success, whereas treatment group and ethnicity were not significant. The number of food records participants completed in the first 3 weeks of treatment did not significantly predict weight loss when examined in this multivariable context.

As with the univariable analyses, the multivariable analyses were repeated with weight loss success derived from BLCF data. Results were not substantively different from those presented here.

Discussion

The attrition that occurs in most obesity treatment studies significantly limits the ability to analyze and interpret outcome data. Reducing the amount of attrition that occurs will improve the quality of data collected in these trials. Of greater clinical significance, reducing attrition should enhance weight loss outcomes by affording participants more opportunity to benefit from the intervention. Obesity treatment also might be improved by understanding factors that predict success (i.e., losing $\geq 5\%$ of initial weight in 1 year). Accordingly, this analysis aimed to identify predictors of attrition and success in a weight loss treatment program. In an inclusive examination of pretreatment characteristics and early treatment process variables, younger age and depressive symptoms emerged as the only significant multivariable predictors of attrition, with early weight loss (i.e., in the first 3 weeks of treatment) approaching significance. In the analysis of weight loss success in the full sample, Caucasian ethnicity, fewer depressive symptoms, and greater early weight loss were significant predictors in the multivariable model, with treatment group approaching significance. When only participants who received some level of lifestyle modification were considered (i.e., all but the sibutramine alone group), only lower depression scores and greater early weight loss significantly predicted weight loss success at 1 year.

Attrition

Other studies have found that older participants were more likely than younger ones to finish weight loss programs (e.g., Honas et al., 2003; Dalle Grave et al., 2004, 2005). We suspect that older participants may have more stable and predictable responsibilities, as well as greater motivation to work toward weight loss due to greater health concerns or health-related impairments in quality of life. The factors explaining the relationship between age and attrition must be identified so that steps can be taken to minimize attrition among younger participants, perhaps by using technology to reduce the burden of on-site meetings or by using motivation enhancement techniques to promote their commitment to the program.

Participants who had fewer symptoms of depression at baseline also were more likely to complete treatment, as observed in other studies (Teixeira et al., 2004; Clark et al., 1996). The demands of a weight loss program may feel overwhelming for participants with greater

depressive symptoms given the reduced energy, motivation, and concentration that characterize this condition. Encouraging depressed participants to obtain treatment for their mood before or during their enrollment in a weight loss program may reduce attrition. Alternatively, such participants might need additional support or structure from their weight loss program to maximize their level of participation.

The amount of weight lost during the first 3 weeks of treatment had a marginal effect on reducing attrition. Despite the lack of statistical significance ($p = .06$), the direction of the effect is in the expected direction and suggests that early success may motivate continued participation.

Weight Loss Success

The univariable effect of treatment group on weight loss is not surprising and is in keeping with Wadden et al.'s report of the randomized controlled study's primary findings (Wadden et al., 2005). Combining lifestyle modification with sibutramine significantly improved the odds of weight loss success as compared to medication alone. The two treatment modalities promote weight loss through complementary mechanisms and their effects are additive (Wadden, et al., 2001). When the sibutramine only group was removed from the multivariable analysis, there were no differences among the other treatment groups. This finding differs from what Wadden et al (2005) reported in their original study in comparing the percentage of participants in each group who had lost 5% or more of initial weight (a secondary outcome in that study for which a last-observation-carried-forward analysis was used).

The finding that ethnicity was significantly related to weight loss in our analysis of the full sample is consistent with previous research. Several other investigations found that ethnic minority participants lost less weight than their Caucasian counterparts (e.g., Kumanyika, Obarzanek, Stevens, Hebert, & Whelton, 1991; Stevens et al., 2001). Small but significant differences in resting metabolic rate between African American and Caucasian women (Foster, Wadden, & Vogt, 1997) – who represent 27% and 49% of the sample, respectively – may account for some of the difference in weight loss. However, additional research is needed to identify potentially modifiable factors responsible for the smaller weight losses observed in ethnic minority participants, as compared with Caucasians. In addition, ethnicity was not a significant predictor of weight loss when only the groups that received some form of lifestyle modification (i.e., all groups but sibutramine alone) were included in the multivariable analysis. This suggests that treatment type moderated the effect of ethnicity in the present study, such that the difference between Caucasian and non-Caucasian participants was limited to those who received sibutramine alone. The implications of this finding are unclear.

The second baseline variable that was found to predict weight loss success – depressive symptoms – adds to the inconsistency that characterizes the existing literature. In contrast to studies that found little or no effect of mood on weight loss (see Teixeira et al., 2005) we found that higher baseline depression scores significantly reduced the likelihood of success. We note, however, that the mean BDI-II score of 8.6 in this sample was well below the cutoff for likely clinically significant depression (i.e., 14; Beck et al., 1996) and that persons believed to have a significant mood disorder were excluded from the randomized controlled trial (Wadden et al., 2005). Had clinically depressed persons been included, the effect likely would have been stronger. Nonetheless, our findings suggest that even depressive symptoms of subclinical severity may hinder patients' ability to make behavioral changes that support weight loss.

Participants' early weight loss was a strong predictor of weight loss success at 1 year. This finding is consistent with previous research (Craighead et al. 1981; Dubbert & Wilson, 1984; Wadden et al., 1992; Finer et al. 2006) and demonstrates that initial success portends long-term success. This finding suggests that specific strategies for reducing energy intake and

increasing energy expenditure should be offered as early as possible (and as early as can be done safely, especially in persons on hypoglycemic medications or at particular risk of cardiac events). By contrast, many lifestyle modification programs include one or two sessions in which participants are introduced and oriented to the program before they are instructed to reduce their intake and increase their energy expenditure. The predictive ability of early weight loss also supports the use of a behavioral run-in period that requires study candidates to meet a performance criterion (i.e., a small weight loss) before they can be randomized into an efficacy trial of a weight loss program or product. We note, however, that completion of food records during the first 3 weeks of treatment did not predict weight loss success in participants who were instructed to record their intake. Given that food record completion throughout a lifestyle modification program is frequently associated with weight loss outcomes (Baker & Kirschenbaum, 1993; Wadden et al., 1997; Hollis et al., 2008), 3 weeks may be too short a period to have predictive power.

Conclusions

This analysis has several limitations. There are certainly factors that may influence attrition or weight loss (e.g., treatment acceptability, motivation to change) that were not examined in this study. Although several types of treatment were offered in this study (medication, lifestyle modification, combination therapy), the results may not be generalizable to other interventions or to treatment offered in other settings (e.g., commercial programs). Future research should explore the mechanisms that explain the relationships between the factors identified here and treatment outcomes. Additionally, future endeavors may seek to determine how enrollment criteria, as well as treatment type, duration, and delivery method (e.g., on-site or remote contacts), can be modified to reduce attrition and promote weight loss success.

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Table 1

Descriptive characteristics of sample.

Variable	N (%) [*]	Mean (SD)
Treatment Group		
Sibutramine alone	55 (24.6)	
Sibutramine + brief lifestyle	54 (24.1)	
Sibutramine + lifestyle modification	60 (26.8)	
Lifestyle modification alone	55 (24.6)	
Sex		
Male	44 (19.6)	
Female	180 (80.4)	
Age (years)		43.8 (10.2)
Ethnicity		
Caucasian	146 (65.2)	
Other	76 (33.9)	
Education		
< 12 years	37 (16.5)	
13 – 15 years	75 (33.5)	
16 years	60 (26.8)	
> 17 years	50 (22.3)	
Marital Status		
Married	127 (56.7)	
Other	94 (42.0)	
Distance from clinic (miles)		15.9 (14.8)
Travel time to clinic (minutes)		24.9 (16.8)
Baseline weight (kg)		106.9 (17.2)
Body mass index (kg/m ²)		37.8 (4.2)
Long weight loss attempts, past year		2.5 (3.6)
Short weight loss attempts, past year		11.2 (45.3)
Years since onset of overweight		25.9 (12.2)
Number of previous 10 lb losses		3.0 (2.2)
Weight change in previous 6 months		
Stable or lost	94 (42.0)	
Increased 5 – 10 lb	67 (29.9)	
Gained > 10 lb	61 (27.2)	
Weight loss goal (% initial weight)		28.2 (8.4)
BDI-II score		8.6 (6.5)
History of significant emotional distress		
No	159 (71.0)	
Yes	61 (27.2)	
Past or present mental health treatment		
No	166 (74.1)	
Yes	58 (25.9)	
Stress in past 6 months		

Variable	N (%) [*]	Mean (SD)
Average or less	106 (47.3)	
More than usual	74 (33.0)	
Much more than usual	41 (18.3)	
Anticipated stress in next 6 months		
Average or less	164 (73.2)	
More than usual	45 (20.1)	
Much more than usual	11 (4.9)	
Self-esteem		
Positive	104 (46.4)	
Mixed	70 (31.3)	
Negative	46 (20.5)	
Binge eating behavior		
None	73 (32.6)	
Objective overeating episodes	51 (22.8)	
Subjective binge episodes	18 (8.0)	
Objective binge episodes	70 (31.3)	
Number of alcoholic drinks per week		2.0 (3.0)
Tobacco use		
Never smoker	91 (40.6)	
Former smoker	111 (49.6)	
Current smoker	12 (5.4)	
Attendance in first 3 weeks (% of scheduled visits)		94.2 (14.9)
Food records at week 3 (days completed)		12.8 (5.6)
Weight loss at week 3 (% of baseline weight)		2.4 (1.5)

* Numbers may not sum to 224, as some items were not answered by all participants. Furthermore, percentages were derived from the full sample and, thus, they may not sum to 100%.

Table 2
Results of univariable logistic regression analyses to predict attrition and weight loss success.

Variable	Attrition			Weight Loss		
	OR	95% CI	P	OR	95% CI	P
Treatment Group (Sibutramine alone)			0.94			0.01
Sibutramine + brief lifestyle	1.02	0.39 – 2.70		1.89	0.88 – 4.05	
Sibutramine + lifestyle	1.01	0.39 – 2.61		3.78	1.74 – 8.18	
Lifestyle alone	0.77	0.28 – 2.12		1.81	0.85 – 3.89	
Sex (Male)			0.45			0.32
Female	1.44	0.56 – 3.69		1.41	0.72 – 2.73	
Age*	0.95	0.92 – 0.99	0.007	1.01	0.99 – 1.04	0.41
Ethnicity (Caucasian)			0.35			0.003
Other	1.40	0.69 – 2.85		0.42	0.24 – 0.74	
Education (≤ 12 years)			0.05			0.87
13 – 15 years	0.36	0.14 – 0.96		1.08	0.49 – 2.38	
16 years	0.26	0.09 – 0.79		1.38	0.61 – 3.14	
≥ 17 years	0.75	0.29 – 1.95		1.14	0.49 – 2.68	
Marital Status (Married)			0.39			0.24
Other	1.36	0.68 – 2.71		0.72	0.42 – 1.24	
Distance from clinic*	0.98	0.95 – 1.02	0.34	1.03	1.003 – 1.05	0.03
Travel time to clinic*	0.99	0.96 – 1.01	0.34	1.02	1.00 – 1.04	0.06
Baseline weight*	1.01	0.99 – 1.03	0.18	0.99	0.98 – 1.01	0.23
Baseline BMI*	1.05	0.97 – 1.14	0.22	1.00	0.94 – 1.06	0.89
Long weight loss attempts, past year*	0.98	0.88 – 1.09	0.70	1.01	0.94 – 1.08	0.86
Short weight loss attempts, past year*	0.96	0.91 – 1.02	0.18	1.00	1.00 – 1.01	0.53
Years since onset of overweight*	0.95	0.92 – 0.99	0.005	1.03	1.01 – 1.05	0.01
Number of previous 10 lb losses*	0.90	0.76 – 1.07	0.23	1.05	0.94 – 1.19	0.39
Weight change in previous 6 months(Stable or lost)			0.42			0.64
Increased 5 – 10 lb	1.12	0.48 – 2.65		0.74	0.39 – 1.39	
Gained > 10 lb	1.70	0.75 – 3.88		0.89	0.47 – 1.70	
Weight loss goal (% initial weight)*	13.17	0.22 – 807.16	0.22	0.48	0.02 – 11.57	0.65
BDI-II score*	1.07	1.01 – 1.12	0.02	0.96	0.92 – 1.00	0.06

Variable	Attrition			Weight Loss		
	OR	95% CI	P	OR	95% CI	P
History of significant emotional distress (No)			0.27			0.79
Yes	0.63	0.27 – 1.45		0.93	0.51 – 1.67	
Past or present mental health treatment (No)			0.40			0.83
Yes	0.70	0.30 – 1.62		1.07	0.59 – 1.94	
Stress in past 6 months (Average or less)			0.43			0.18
More than usual	0.85	0.38 – 1.93		0.94	0.52 – 1.70	
Much more than usual	1.58	0.66 – 3.78		0.51	0.24 – 1.06	
Anticipated stress in next 6 months (Average or less)			0.27			0.97
More than usual	0.40	0.13 – 1.21		1.06	0.55 – 2.06	
Much more than usual	0.92	0.19 – 4.45		1.12	0.33 – 3.80	
General feelings about self (Positive)			0.02			0.33
Mixed	1.75	0.75 – 4.10		0.86	0.47 – 1.57	
Negative	3.35	1.41 – 8.00		0.59	0.29 – 1.18	
Binge eating behavior (None)			0.29			0.33
Objective overeating episodes	0.90	0.32 – 2.50		1.73	0.84 – 3.57	
Subjective binge episodes	1.13	0.28 – 4.55		0.97	0.34 – 2.74	
Objective binge episodes	1.95	0.85 – 4.50		1.62	0.84 – 3.13	
Number of alcoholic drinks per week*	0.94	0.82 – 1.08	0.35	1.01	0.92 – 1.10	0.86
Tobacco use (Never smoker)			0.72			0.80
Former smoker	0.84	0.41 – 1.75		0.88	0.51 – 1.53	
Current smoker	1.45	0.36 – 5.94		1.25	0.37 – 4.25	
Attendance in first 3 weeks (% of scheduled visits)*	0.10	0.01 – 0.69	0.02	4.13	0.67 – 25.65	0.13
Food records at week 3 (days completed)*	0.95	0.89 – 1.02	0.18	1.07	1.02 – 1.14	0.01
Weight loss at week 3 (% of baseline weight)*	0.81	0.64 – 1.03	0.09	1.89	1.51 – 2.37	<0.001

OR = Odds ratio, CI = Confidence interval. For categorical variables, reference groups are listed in parentheses. Continuous variables are marked with *, and odds ratios refer to one unit increases.

Table 3

Results of multivariable logistic regression analysis to predict attrition.

Variable	OR	95 % CI	P
Treatment Group (Sibutramine alone)			0.84
Sibutramine + brief lifestyle	1.21	0.37 – 3.97	0.75
Sibutramine + lifestyle modification	1.01	0.29 – 3.52	0.99
Lifestyle modification alone	0.68	0.20 – 2.34	0.54
Age	0.94	0.89 – 0.99	0.03
Education (≤ 12 years)			0.11
13 – 15 years	0.70	0.21 – 2.31	0.55
16 years	0.53	0.13 – 2.12	0.37
≥ 17 years	2.38	0.64 – 8.85	0.20
Years since onset of overweight	0.98	0.93 – 1.02	0.31
BDI-II score	1.09	1.01 – 1.17	0.02
General feelings about self (Positive)			0.85
Mixed	1.33	0.47 – 3.81	0.59
Negative	1.35	0.37 – 4.88	0.65
Attendance in first 3 weeks (% of scheduled visits)	3.14	0.86 – 114.01	0.53
Weight loss at week 3 (% of baseline weight)	0.72	0.52 – 1.01	0.06

OR = Odds ratio, CI = Confidence interval. Treatment group, education, and general feelings about self are categorical variables and reference groups are listed in parentheses. Age, years since onset of overweight, BDI-II score, and weight loss at week 3 are continuous variables, and the odds ratios refer to one unit increases.

Table 4

Results of multivariable logistic regression analysis to predict weight loss response.

Variable	OR	95 % CI	P
Treatment Group (Sibutramine alone)			0.07
Sibutramine + brief lifestyle	1.41	0.56 – 3.64	0.47
Sibutramine + lifestyle modification	3.66	1.44 – 10.88	0.01
Lifestyle modification alone	2.23	0.96 – 6.41	0.09
Ethnicity (Caucasian)	0.58	0.23 – 0.97	0.04
Distance from clinic	1.02	0.99 – 1.04	0.29
Years since onset of overweight	1.01	0.98 – 1.05	0.39
BDI-II score	0.95	0.90 – 0.997	0.04
Weight loss at week 3 (% of baseline weight)	1.73	1.33 – 2.27	<0.001

OR = Odds ratio, CI = Confidence interval. Treatment group and ethnicity are categorical variables and reference groups are listed in parentheses. Distance from clinic, years since onset of overweight, BDI-II score, and weight loss at week 3 are continuous variables, and the odds ratios refer to one unit increases.

Table 5

Results of multivariable logistic regression analysis to predict weight loss response among groups that were instructed to keep food records.

Variable	OR	95 % CI	P
Treatment Group (Sibutramine + brief lifestyle)			0.29
Sibutramine + lifestyle modification	2.30	0.82 – 6.49	0.11
Lifestyle modification alone	1.54	0.59 – 4.05	0.38
Ethnicity (Caucasian)	0.89	0.35 – 2.24	0.81
Distance from clinic	1.03	0.99 – 1.06	0.12
Years since onset of overweight	1.00	0.97 – 1.04	0.89
BDI-II score	0.92	0.86 – 0.99	0.02
Food records at week 3 (days completed)	1.01	0.94 – 1.10	0.72
Weight loss at week 3 (% of baseline weight)	2.06	1.45 – 2.93	<0.001

OR = Odds ratio, CI = Confidence interval. Treatment group and ethnicity are categorical variables and reference groups are listed in parentheses. Distance from clinic, years since onset of overweight, BDI-II score, food records at week 3, and weight loss at week 3 are continuous variables, and the odds ratios refer to one unit increases.