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Weight Loss Readiness in Middle-Aged Women: Psychosocial Predictors of Success for Behavioral Weight Reduction

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Accurate prediction of weight loss success and failure has eluded researchers for many years. Thus, we administered a comprehensive psychometric battery before a 4-month lifestyle behavioral weight reduction program and analyzed weight changes during that period to identify baseline characteristics of successful and unsuccessful participants, among 112 overweight and obese middle-aged women (age, 47.8 ± 4.4 *years;* BMI, 31.4 ± 3.9 *kg/m*^{2}*). Mean weight and percentage fat losses among the 89 completers were* -5.4 *kg and* -3.4 *%, respectively* ($p < .001$). *A higher number of recent dieting attempts and recent weight loss, more stringent weight outcome evaluations, a higher perceived negative impact of weight on quality of life, lower self-motivation, higher body size dissatisfaction, and lower self-esteem were associated with less weight loss and significantly distinguished responders from nonresponders among all participants. These findings are discussed as to their usefulness (i) to screen individuals before treatment, (ii) to provide a better match*

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between interventions to participants, and (iii) to build a weight loss readiness questionnaire.

KEY WORDS: weight loss; readiness; psychosocial predictors; overweight women.

INTRODUCTION

Dissatisfaction with body weight and body image concerns are pervasive throughout our culture. Among women between 40 and 60 years, of age, more than 80% report that they are either trying to lose weight (~50% of all women) or trying to maintain weight (Serdula *et al.*, 1999). Unfortunately, many people who attempt to lose weight in commercial or research-based programs have difficulty losing and/or maintaining weight loss. Average rates of weight loss for weight loss programs are of the order of 0.4 to 0.7 kg/week (Miller *et al.*, 1997; Wadden and Foster, 2000; Wing, 1998). However, some subjects (*responders*) far exceed the mean weight changes, while others (*nonresponders*) drop out or finish the study considerably below their expectations and the goals established by the intervention team. Often, these participants do not lose enough weight to improve health and quality of life and some may even gain weight during the "weight loss" phase of the program.

Despite substantial progress in weight management programs since the first studies were published in the early 1970s, which has undoubtedly resulted in higher levels of success (Wadden and Sarwer, 1999), some important questions persist. One limitation of present interventions is their lack of individualization. In spite of many calls for more patient- or profile-matched approaches (Brownell and Wadden, 1991; Schlundt *et al.*, 1991; Wadden and Sarwer, 1999; Yass-Reed *et al.*, 1993), programs remain for the most part unidimensional, present few options to participants, and generally cannot adapt to subjects' characteristics. A few exceptions to this trend exist (Feuerstein *et al.*, 1989; Renjilian *et al.*, 2001), but results have been mixed. In addition, progress in eliciting short-term weight loss has not been met by a comparable improvement in long-term weight management, which remains a great challenge in the field (Jeffery *et al.*, 2000). While efforts to improve maintenance programs have been under way (Latner *et al.*, 2000; Perri *et al.*, 1992, 1997), revisiting the initial treatment phase may be necessary. Better defining the importance of the characteristics of this initial phase (e.g., definition of success, rate and amount of weight loss) and information gathered during it or even before participants start may prove to be associated with long-term outcomes (Astrup and Rossner, 2000; Rossner, 1992). Finally, dropout rates are still too large to be ignored. The average attrition increased from

about 11% in 1974 to about 21% in 1986 (Brownell and Kramer, 1994) and appears to have stabilized at about 20% in the last 10–15 years (Wadden and Foster, 2000). Together, noncompleters and the least successful completers represent a large group of individuals not being served by current programs.

Given the large number of people trying to lose weight, the identification of reliable predictors of successful and unsuccessful short- and long-term outcomes remains an important goal. While the majority of attempts have yielded largely disappointing results, and, with the possible exception of self-efficacy measures, no consistent predictor of weight reduction has been identified (USDHHS, 2000; Wadden and Letizia, 1992), newer instruments have become available in recent years (e.g., weight outcome evaluations, weight-related quality of life), and several other constructs, assessed by more well-established questionnaires that have not frequently been used as candidates predictors of weight loss success (e.g., exercise determinants, self-motivation, body and self cathexis), should be explored.

Successful screening of subjects who are unlikely to meet even minimal weight loss goals (or that are more likely to drop) would spare them further disappointment and make it possible to direct them to alternative approaches. Also, it may be advantageous to study these individuals separately to understand better the factors that limit their weight reduction. Matching interventions to patients, saving resources, and increasing program efficacy are potential benefits of adopting readiness/profiling approaches. Although the study of readiness for weight loss has been frequently recommended over the past 20 years (Brownell, 1984; Brownell and Rodin, 1994; Rossner, 1992; Wadden and Sarwer, 1999), including most recently in the National Institutes of Health's *The Practical Guide to the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults* (USDHHS, 2000), a valid readiness questionnaire with adequate predictive capacity for weight loss is not available (Fontaine *et al.*, 1997).

The aim of this study was to identify baseline psychosocial correlates of short-term (4-month) changes in body weight in middle-aged women participating in a lifestyle weight loss intervention. Given the paucity of positive results reported in the literature on this point, we selected an exploratory approach to identify potential predictors of weight loss, drawing on a large database of psychometric measures collected prior to initiating weight loss. We sought to describe the characteristics of responders and nonresponders with the long range goal of developing profiles of participants with a high or low probability of weight loss success. We regard the description of responders and nonresponders as an important step in developing a valid weight loss readiness questionnaire.

METHOD

Participants

This study was part of a 2-year weight loss and weight maintenance lifestyle intervention. Data reported herein refer to the initial 4 months of the study, which was specifically designed to induce weight loss in middle-aged, overweight women. Subjects were recruited from the community through newspaper and TV advertisements. Of the 466 women who inquired about the study, 35% (168 individuals) met all inclusion criteria and were invited to an orientation session. Subjects were required to be between 40 and 55 years of age, have a body mass index (BMI) between 25.0 and 38.0 kg/m^2, be a nonsmoker, and be free from major illnesses to be eligible for the study. Of the 168 women who attended an orientation session, 142 volunteered for the study. During the baseline run-in phase, 26 women failed to comply with the requirements and were excluded, and 4 dropped out voluntarily, leaving 112 women who entered the intervention. All participants agreed to refrain from participating in any other weight loss program. The University of Arizona's Human Subjects Institutional Review Board approved the study and all participants gave written informed consent prior to participation in the study.

Measures

Body Habitus

Weight was measured twice, to the nearest 0.1 kg (the average was used), with subjects wearing light clothes and without shoes, using an electronic scale (SECA Model 770, Hamburg, Germany). Height was measured twice, to the nearest 0.1 cm (the average was used). BMI as kilograms per square meter was calculated from weight (kg) and height (m). Dual-energy X-ray absorptiometry (DXA; Lunar DPX-IQ, software version 4.6) was used to measure fat mass and body fat percentage. Waist and hip circumferences (cm) were measured three times by one trained technician, following the procedures from the Arlie Conference (Lohman *et al.*, 1988). The waist-to-hip ratio (WHR) was derived from the waist and hip circumferences.

Physical Activity

Leisure-time physical activity was assessed at baseline and follow-up, using the Seven-Day Physical Activity Recall interview (Sallis *et al.*, 1985). This instrument measures leisure and occupational energy expenditure during the

7 days prior to the interview. Energy expenditure was calculated based on self-reported time spent in light, moderate, hard, and very hard activities. Exercise energy expenditure (EEE) was derived from adding the energy expenditure of all activities of at least moderate intensity ($\geq$3.8 METs), equivalent to walking briskly (Ainsworth *et al.*, 2000).

Psychosocial Variables

We measured a comprehensive battery of potential predictors of weight loss, covering several areas considered to be relevant for weight management, including eating- and exercise-related variables, body image, and quality of life (Faith and Allison, 1996; Faith *et al.*, 1995, 1997; St. Jeor, 1997). Weight/dieting history, weight outcome evaluations/expectations, and psychological measures (mood, self-esteem, self-motivation) were also tested as potential prospective predictors of success.

Questionnaires used in this study consisted of previously validated instruments available in the literature, whose psychometric qualities have been demonstrated. The variables reported herein were selected from the larger psychometric database as the most likely to predict weight loss prospectively.

Dieting/weight history was assessed by a questionnaire developed specifically for this study, from which six questions were selected as potentially related to weight loss success. They included number of recent diets, years at current weight, recent weight losses, life frequency of $\geq$10-lb weight fluctuations, age at which subjects started dieting to control their weight, and perceived pressure to maintain their weight.

Weight outcome evaluations were assessed by four questions adapted from the Goals and Relative Weights Questionnaire (Foster *et al.*, 1997), asking subjects to indicate what would be their "dream" weight (if they could chose any weight) and what would be their "happy," "acceptable," and "disappointing" weights by the end of the 16-week intervention. Each outcome evaluation (e.g., "acceptable" weight) was used after calculating it as a percentage of the actual weight at study entry.

To assess quality of life, we used general and obesity-specific measures. The Short-Form (SF-36) quality of life survey is a widely used instrument to assess health-related (general) quality of life (Ware *et al.*, 1993). Its eight dimensions can be adequately summarized into two composite scores, physical health and mental health (Ware and Kosinski, 2001), higher scores indicating higher health-related quality of life. In our sample, the reliability estimates (Cronbach's α) for the physical and mental health subscales were .87 and .78, respectively.

The Impact of Weight on Quality of Life (IWQOL) questionnaire assessed the influence that an individual's weight has had on her health, social

and interpersonal life, work, mobility, self-esteem, sexual function, activities of daily living, and eating in the past week (Kolotkin *et al.*, 1995). The questionnaire consists of 74 items and is administered in a 5-point Likert format ranging from 1 ("always true") to 5 ("never true"). Higher scores indicate lower perceived impact of weight or higher weight-related quality of life. The α estimate in our sample was .96 for the IWQOL.

General social support was assessed by the average of five items describing different sources of support as originally developed for the Medical Outcomes Study (MOS) (Sherbourne and Stewart, 1991). Subjects indicate the frequency of each supportive event ("having someone to listen to you," "having someone that listens to you," etc.) on a 5-point Likert scale. Higher scores indicate higher perceived social support. The α estimate for this scale was .86.

Depression was assessed by the Beck Depression Inventory (BDI), consisting of 21 items administered in a 4-point ordered scale (Beck and Steer, 1987). Each item corresponds to a specific manifestation of depression (sadness, guilt, suicidal thoughts, etc.). Individual items are summed for a total depression score, with higher scores indicating a higher level of depressive symptoms. The α estimate for the BDI was .83.

Self-esteem was assessed by an adapted version of Rosenberg's (1965) Self-Esteem/Self-concept questionnaire, which assesses an individual's level of self-respect and positive self-opinion. It consists of 13 statements (e.g., "I certainly feel useless at times"), to which subjects are asked to respond either "agree" or "disagree." A composite score of all items is obtained, with higher scores indicating higher self-esteem. The α estimate for the Rosenberg instrument was .63.

The Self-Motivation Inventory (SMI) was used to measure a general tendency to persevere, finish tasks initiated, maintain self-discipline, and motivate oneself (Dishman and Ickes, 1981). This inventory consists of 40 items, administered in a 5-point Likert format ranging from 1 ("extremely uncharacteristic of me") to 5 ("extremely characteristic of me"). All items are averaged to provide one composite score, with higher scores indicating higher self-motivation. The Cronbach's α estimate for the SMI was .94 in our sample.

Binge eating was assessed by the Binge Eating Scale (BES), which measures the severity of binge eating symptoms related to feelings, cognitions, and behavioral manifestations (Gormally *et al.*, 1982). Each of the 16 items contains statements that reflect a range of severity for each characteristic and have assigned weights. The total score results from summing the individual weights for the 16 items. High scores indicate more binge eating symptoms. The α estimate for the BES was .85.

Eating self-efficacy was assessed by the Eating Self-Efficacy Scale (ESES) and by the Weight Efficacy Life-Style Questionnaire (WEL). The

ESES (Glynn and Ruderman, 1986) consists of 25 items measuring two dimensions of efficacy to control overeating: negative affect and socially accepted circumstances. It is administered in a 7-point Likert format ranging from 1 ("no difficulty controlling eating") to 7 ("most difficulty controlling eating"). Higher scores indicate a lower level of self-efficacy for controlling overeating. The WEL (Clark *et al.*, 1991) measures five dimensions of efficacy for weight management: availability, negative emotions, physical discomfort, positive activities, and social pressure, scored with a 10-point Likert-type answer key. Higher scores indicate higher self-efficacy. Reliability estimates were .94 for the ESES and .92 for the WEL.

Cognitive (eating) restraint, eating disinhibition, and perceived hunger were assessed with the Eating Inventory (EI), also known as the Three-Factor Eating Questionnaire, a 51-item questionnaire that measures cognitions and behaviors associated with eating (Stunkard and Messick, 1988). The cognitive restraint scale measures conscious attempts to monitor and regulate intake (α estimate, .76), the disinhibition scale measures dysregulation of eating in response to cognitive or emotional clues (α estimate, .77), and the hunger scale measures feelings or perceptions of hunger (α estimate, .77). High scores indicate higher cognitive restraint, disinhibition, and more feelings of hunger.

The Dieting Readiness Test (DRT) is a commonly used scale that was developed by the authors of the popular LEARN program to measure dieting (and weight loss) readiness and motivation (Brownell, 1997). It consists of 23 items divided into six sections (goals and attitudes, hunger and eating, control over eating, binge eating and purging, emotional eating, exercise patterns and attitudes) and is administered in a 5-point Likert format. High scores indicate higher readiness. A total score was calculated by summing scores for each section. The α estimate was .58 for the DRT.

Self-efficacy for exercise was assessed with the Self-Efficacy for Exercise Behaviors scale (Sallis *et al.*, 1988). This instrument was developed to measure an individual's belief or conviction that he/she can "stick with" an exercise program for at least 6 months in varying circumstances (e.g., when time is short, when undergoing a major life change) in the dimensions of making time for exercise and resisting relapse. Subjects answered the 11-item scale through a 5-point Likert-type answer key, ranging from A ("sure I could not do it") to E ("sure I could do it"), with higher scores indicating higher self-efficacy. The α estimate was .84 for this scale.

Exercise perceived barriers were assessed with 11 items from a previously validated scale (Steinhardt and Dishman, 1989), which was developed to measure the extent to which the elements of time (e.g., being "too busy"), effort (e.g., being "too tired"), and other obstacles (e.g., "limiting health reason") provide barriers to habitual physical activity. Some items were

removed from the original scale since they did not apply to our population (e.g., "exercise interferes with school"). It is administered in a 5-point Likert format ranging from A ("strongly disagree") to E ("strongly agree"). A higher score indicates more perceived barriers. The reliability estimate for this scale was .67 in our sample.

We measured exercise-specific social support with 13 items from a scale developed by Sallis *et al.* (1987) to assess support from family and friends targeted at exercise behavior over the past 3 months in the dimensions of participation/involvement (e.g., "friends/family offered to exercise with me") and rewards/punishment (e.g., "criticized me for exercising"). Originally, this instrument measured support from friends and family separately, while in our study they were assessed together, i.e., in the same scale. It is administered in a 5-point Likert format ranging from 1 ("none") to 5 ("often"). Higher scores indicate higher perceived social support. The α estimate for this scale was .86.

Three questionnaires were used to assess body image. The Body Shape Questionnaire measures concerns with body shape, in particular, the experience of "feeling fat" (Cooper *et al.*, 1987). The questionnaire consists of 34 items and is administered in a 6-point Likert format ranging from 1 ("never") to 6 ("always"). The sum of all questions (e.g., "Have you felt so bad about your shape that you have cried?") provides a total score for body shape concerns, with higher scores indicating higher body shape concerns. The α estimate was .95 for this questionnaire.

Body size dissatisfaction was assessed through the Body Image Assessment Questionnaire, consisting of nine body silhouettes of increasing size, from which subjects are asked to choose their self (closest to their actual size) and ideal figures (Williamson *et al.*, 1989). The dissatisfaction score is achieved by subtracting ideal from actual size, with higher scores indicating a higher self-ideal disparity or higher body size dissatisfaction (Williamson *et al.*, 1993).

The Body Cathexis Questionnaire consists of 44 items listing various parts or characteristics of one's body and body function (ears, width of shoulders, voice, flexibility, etc.) and each item is measured on a 5-point Likert scale, from "have strong negative feelings" to "have strong positive feelings" (Secord and Jourard, 1953). The sum of all scores provides an overall body image index, with higher scores indicating more positive body image. The α estimate in our sample was .97 for this instrument.

Intervention

After baseline testing, subjects were randomly assigned to four groups of approximately equal size (27–29 subjects/group), which met with the

intervention team once a week, for 150 min per session, over 16 consecutive weeks. Physical activity, nutrition, psychology, and behavior modification experts presented subjects with information and interactive activities targeting healthier lifestyles and weight reduction. All groups received the same 16-week intervention. Subjects were encouraged to make progressive and realistic changes in their lifestyle, primarily reducing energy intake and increasing physical activity and energy expenditure, resulting in a moderate daily energy deficit (less 300–500 kcal/day). Individualized goals for energy intake (EI) and expenditure (EE) were provided to all subjects, and slow, progressive weight loss (about 0.5 kg a week) was recommended. Cognitive-behavioral strategies used to improve compliance included self-monitoring, self-efficacy enhancement, relapse prevention, contingency management, and social support.

Statistical Analysis

Statistical analyses were completed using the Statistical Package for the Social Sciences (SPSS, version 10.0.5). Measures of central tendency and distribution were examined at baseline and 4 months, as well as tests for normality and homoscedasticity. The Last Observation Carried Forward (LOCF) method was used to impute follow-up weight for 21 of the 23 non-completers based on weight records collected weekly for all subjects (two subjects who dropped out were measured at follow-up). The LOCF has been used before in weight loss research (Andersen *et al.*, 1999) and is a common way of handling missing data in longitudinal clinical trials. Although this method has limitations, it is the best option when strong time trends are not expected (as in the case of a short-term intervention) and when it is reasonable to assume that the postdrop value remained relatively unchanged (Mazumdar *et al.*, 1999), as was the case in this trial (see Results).

Correlational analysis was used to estimate the linear relationship between independent and dependent measures and among dependent measures. Spearman rank–order correlations were used whenever questionnaire data involved variables with nonnormal distributions. Among all other variables, Pearson correlation coefficients were used. Differences between baseline and 4-month outcomes were examined with paired t tests, whereas differences between completers and noncompleters were studied with independent sample Student t tests. Means among multiple subgroups (e.g., weight loss divided by tertile) were compared with analysis of variance (ANOVA) followed by multiple comparison (post hoc) tests, performed using Tukey's honestly significant difference test. Discriminant function

analysis was performed to predict group membership (within tertiles of weight loss success) based on baseline predictors. Wilks' λ method was used to test variables in stepwise fashion in preliminary analyses until the final function was determined. Multiple regression analysis was performed to assess the relationships among independent variables and the amount of variance in weight loss that could be predicted. Type I error was set at $\alpha = .05$ for all tests.

To adjust significance values for multiple testing in correlational analysis and analysis of variance, Holm's method was used (Aickin and Gensler, 1996). This method is superior to the Bonferroni method for protecting against type II error and increasing statistical power while also offering some protection against inflation of type I error. A large number of variables were tested in this study, a procedure we believe was warranted and appropriate given the exploratory nature of these analyses. However, adjusting for the number of statistical tests (using any available method) results in very stringent p values, which may increase type II error and lead to an increase in reporting nonsignificant findings that are significant in the population.

RESULTS

Baseline Characteristics

The 112 women who volunteered for the study (age, 47.8 ± 4.4 years; mean ± SD) were primarily non-Hispanic (86%) or Hispanic (10%) white, and 45% of the women were postmenopausal (self-report). Forty-six women (41%) had a BMI of between 24.4 and 30.0 kg/m^2 and were considered overweight (USDHHS, 1998). The remaining 66 women (59%) were obese (BMI, >29.9 kg/m^2), either class I ($n = 42$), with a BMI of between 30.0–34.9 kg/m^2, or class II ($n = 24$), with a BMI >34.9 kg/m^2. About 63% ($n = 71$) of the women reported expending less than the minimum recommended 150 kcal per day in moderate or vigorous physical activities (USDHHS, 1996), with 18% of women ($n = 20$) reporting no leisure-time "brisk" activity.

On average, participants defined 75.9 kg as an "acceptable" body weight after 4 months, which would require an 11.1% (9.5 kg) reduction from their initial weight. The weight subjects indicated that they would be "happy" with after 16 weeks represented an average reduction of 12.6 kg (14.8% from the initial weight). Twenty-one women (19%) had a score of 15 or higher on the Beck Depression Inventory (10.4 ± 6.3; mean ± SD), a cutoff that may indicate clinical depression (Beck and Steer, 1987).

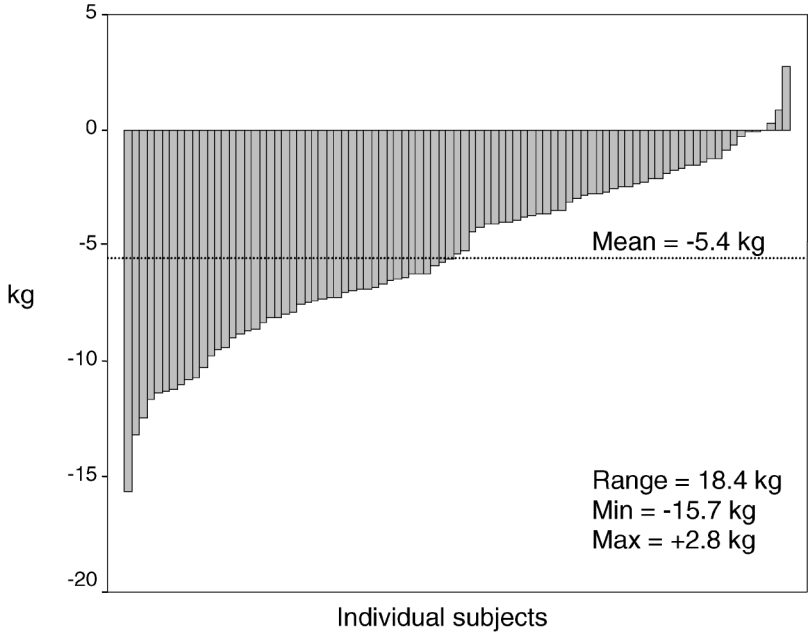

Fig. 1. Individual changes in weight after 4 months ($n = 89$).

Forty-two women (38%) engaged in "moderate binge eating" according to the Binge Eating Scale, scoring 18 or higher (13.8 ± 7.1). No significant differences were found between pre- and postmenopausal women for all baseline characteristics.

Treatment Effects

Of the 112 women who entered the study, 89 women finished the 4-month intervention and complied with all follow-up measurements (21% dropout rate). The most common reasons for dropping out of the study were lack of time (eight subjects) and health issues (six subjects). Among completers, the mean attendance at the 16-week program was 93% (range, 71–100%). The distribution of individual changes in body composition for the 89 participants who finished the 16-week intervention is shown in Fig. 1.

A wide range of responses was observed. For example, the subject losing the most weight (−15.7 kg) contrasts with four subjects who actually gained weight after 4 months. Table I shows baseline and four-month

Table I. Baseline Data and 4-Month Changes for Primary Outcomes (Completers; $n = 89$)

	Baseline		4 months		Changes		
	Mean	SD	Mean	SD	Mean	SD	p^a
Weight (kg)	84.6	12.0	79.2	12.7	−5.38	3.69	<.001
BMI (kg/m^2)	31.0	3.8	29.2	4.0	−1.86	1.43	<.001
Fat mass (kg)	37.6	8.9	32.7	9.6	−4.95	3.54	<.001
Body fat (%)	44.2	5.8	40.8	6.8	−3.41	3.08	<.001
Waist circumference (cm)	94.4	9.1	89.7	10.4	−4.73	3.80	<.001
Waist-to-hip ratio	0.825	0.063	0.819	0.064	−0.006	0.024	.034
Exercise energy expenditure (kcal/day)	132	121	259	146	127	146	<.001

[a] Paired t test.

data for body habitus variables and EEE, all of which were significantly changed ($p < .05$). After 16 weeks, subjects reported a mean increase of 127 kcal/day (890 kcal/week) in EEE. Fifty-three women (60%) reported having met the goal of 1500 kcal expended in exercise per week.

Predictors of Weight-Related Outcomes

The primary aim of this study was to identify baseline prospective correlates of change in weight. Toward this end, several historical and psychosocial variables were assessed at baseline, and associations with changes in outcomes after the 16-week program were analyzed. Baseline weight did not predict changes at 16-weeks for any body habitus variable. Baseline fat (and not weight) was negatively correlated with baseline exercise levels ($r = -.26$, $p < .05$). Initial EEE was inversely related to changes in exercise levels ($r = -.41$, $p < .001$). As expected, change in self-reported exercise was a significant correlate ($r = -.37$, $p < .001$) of change in weight and change in fat (more exercise, larger weight/fat losses). Attendance was also positively associated with weight ($r = -.36$, $p < .001$) and fat losses ($r = -.34$, $p < .01$).

Table II shows correlation coefficients between baseline psychosocial variables and changes in weight for the 89 subjects who completed follow-up measurements (third column). Correlation coefficients for changes in body fat were identical to those for body weight and are not reported. Significant correlations were found for two weight/diet history variables and for self-motivation. Reporting a ≥10-lb weight loss in the previous 2 years, more dieting attempts in the previous year, and less self-motivation were all associated with less weight loss after the intervention.

Table II. Spearman Correlation Coefficients Between Baseline Psychosocial Measures and Changes in Weight (Completers and Whole Sample)

		Change in weight	
		Completers ($n = 89$)	Whole sample ($n = 112$)
Weight/diet history	At least 10-lb loss within past 2 years?	.22*	.26**
	Number of diets in past year	.37***	.35***
	Years at current weight	.19	.19*
	Life frequency of weight up/down (>10 lb)	−.07	.08
	Age when start dieting because of weight/size	.17	.15
	Feel pressure to maintain weight	.17	.15
Weight outcome evaluations	"Dream" weight (as % of initial weight)	−.02	−.09
	"Disappointing" weight (% of baseline)	−.03	−.12
	"Acceptable" weight at 16 weeks (% of baseline)	−.15	−.28**
	"Happy" weight at 16 weeks (% of baseline)	−.10	−.26**
Quality of life and social support	Health-related quality of life, physical (SF-36)	.06	−.07
	Health-related quality of life, mental (SF-36)	−.09	−.17
	Impact of weight on quality of life[a]	−.12	−.19*
	Social support	.05	−.04
Psychological characteristics	Depression	.06	.15
	Self-motivation	−.28**	−.28**
	Self-esteem/self-concept	−.20	−.21*
Eating behavior	Eating restraint	.07	−.02
	Eating disinhibition	−.06	.03
	Perceived hunger	−.07	−.06
	Binge eating	−.04	.05
	Eating self-efficacy[b]	−.06	.08
	Weight managment self-efficacy	.08	.03
	Dieting (weight loss) readiness	−.02	−.02
Exercise behavior	Exercise perceived barriers	.12	.21*
	Exercise social support	.15	.14
	Exercise self-efficacy	−.10	−.19*
Body image	Body shape concerns	.03	.14
	Body size dissatisfaction	.15	.26**
	Body cathexis[c]	−.07	−.18

Note. * $p < .05$; ** $p < .01$; *** $p < .001$ (unadjusted significance values; see text for Holm's adjusted p values). Unless otherwise noted, higher scores indicate a higher value for the characteristic tested (e.g., higher quality of life, higher self-motivation, higher perceived hunger, more body concerns). Since weight change was coded as baseline weight subtracted from 4-month weight, weight loss is represented by a *negative* weight change (thus, a negative correlation coefficient indicates a *positive* correlation with weight *loss*).

[a] Higher score indicates a lower perceived impact of weight on quality of life.

[b] Higher score indicates lower self-efficacy.

[c] Higher score indicates more positive feelings regarding one's body.

To include the baseline data for all participants, we estimated 16-week weight changes for dropouts using the Last Observation Carried Forward (LOCF) method. Weekly weight changes were recorded under conditions similar to those for baseline and follow-up laboratory measurements (by a trained technician and using the same scale, subjects without shoes) except clothing was not standardized. The LOCF method assumes no further change in a subject's weight between the week last attended and the end of the 16-week program. Providing support for this assumption, we observed that at weeks 4, 8, and 12, subjects who later dropped out had a weight loss that was not statistically different from zero at any intermediate period (+0.3, −0.2, and +0.1 kg, respectively, for weeks 4, 8, and 12, $p > .05$).

Correlation coefficients between baseline psychosocial variables and weight outcomes for all 112 subjects are shown in Table II (last column). Having a higher number of recent diets in previous year ($p < .001$), recent weight losses, and higher weight loss expectations (defined by the weight subjects considered "acceptable" or "happy," relative to their starting weight) were some of the strongest predictors of weight loss, as were a higher self-motivation and lower body size dissatisfaction ($p < .01$). Years at current weight, a high perceived impact of weight on quality of life, exercise perceived barriers, and self-efficacy were also significant predictors ($p < .05$). Within impact of weight on quality of life, subscales that correlated significantly were impact on health (Spearman's $\rho = -.20$, $p = .031$) and impact on work (Spearman's $\rho = -.26$, $p = .005$). For exercise perceived barriers, the *obstacles* subscale ("limiting health reason," "too many family obligations") was the only significant correlate (Spearman's $\rho = .22$, $p = .021$), and for exercise self-efficacy the only significant correlate was the *making time* subscale (finding time to exercise even when faced with difficulties such as "after a tiring day at work," when "feeling depressed") (Spearman's $\rho = -.20$, $p = .037$). When p values were adjusted for the number of comparisons being performed, the number of diets in previous year remained a significant predictor (Holm's adjusted $p < .01$).

In addition to bivariate correlations, a multiple regression analysis was performed, entering all significant ($p < .05$) predictors (subscales were used when significant) in a stepwise fashion. This model, with the combination variables listed in Table III, accounted for about 25% of the variance in weight changes. Self-motivation, recent diet attempts and weight losses (>4.5 kg) in previous two years, numbers of years at current weight, and exercise perceived barriers (*obstacles*) were all significant and independent predictors. All other significant correlates in the bivariate analysis (Table II) were no longer significant in this multivariate analysis.

Table III. Multiple Regression Analysis for Changes in Weight (Whole Sample; $n = 112$)

	B	R^2	p
Self-motivation	−1.734	.077	.033
Number of diets in last year	.403	.137	.007
At least 4.5-kg loss in past 2 years	2.210	.193	.007
Years at current weight	.262	.244	.008
Exercise barriers—*obstacles*	1.091	.281	.021

Note. Adjusted $R^2 = .247$; SEE = 3.48 kg; $p < .001$.

Analysis of Successful and Unsuccessful Participants

To achieve a more specific evaluation of the characteristics of successful and unsuccessful participants, the sample ($n = 112$) was divided into three equal groups based on tertiles of weight loss (Table IV; tertile 1 indicates the most successful group, tertile 3 indicates the least successful group). Women within the highest tertile (termed "successful") lost ≥6.4 kg, while subjects who lost only 1.9 kg or less were classified in the least successful group. The successful group included subjects who achieved at least 90% (−6.4 kg) of the target weight loss. The lower cutoff of −1.9 kg represented about 25% of the target weight loss. The three groups were not significantly different for any body habitus or energy expenditure variable at baseline. Table IV shows statistics for baseline descriptive variables and baseline historical and psychosocial predictors for the three groups. Using analysis of variance, the three groups were not different for demographic, baseline body habitus, and baseline energy expenditure. Significant differences were found for nine historical/psychosocial variables. Post hoc analysis describes multiple comparisons among the three groups, using Tukey's HSD test. In most but not all cases, significant differences in psychosocial variables were detected only between the lowest weight loss group and the other two groups (indicated by a superscript *c*). When ANOVA p values were adjusted for the number of tests being performed, the number of diets in the previous year and body size dissatisfaction were still significant (Holm's adjusted $p < .05$). Figure 2 shows scores by tertiles for four of the strongest correlates of weight loss.

A multiple discriminant function analysis was conducted, with all significant (bivariate correlation $p < .05$) predictors entered and using group membership (within tertiles of success) as the dependent variable ($n = 112$). A combination of five predictors (years at current weight, weight loss >4.5 kg in previous 2 years, "acceptable" weight outcome evaluation, self-motivation, and body size dissatisfaction) significantly predicted group membership ($\chi^2 = 37.351$, $p < .001$; Table V). The accuracy to classify most and

Table IV. Comparison of Success Groups for Baseline Psychosocial Variables (Whole Sample; $n = 112$)

Baseline measure	Descriptive statistic (tertile of weight change)						
	1st tertile (most successful)		2nd tertile		3rd tertile (least successful)		
	Mean	SD	Mean	SD	Mean	SD	p^a
n	37		38		37		—
Noncompleters within each group	0		2		21		—
Changes in weight[b] (kg)	−9.0	2.2	−3.8	1.4	−0.1	1.4	—
Attendance[b] (%)	94.8	0.1	90.0	0.3	82.8	0.2	<.001[c]
At least 4.5-kg loss within past 2 years? (% yes)	21.6	—	23.7	—	51.4	—	.008[c]
Number of diets in past year	1.49	2.3	1.66	1.6	3.30	2.9	.001[c]
Years at current weight	0.95	1.3	2.37	4.1	2.27	3.0	.085
"Acceptable" weight after 16 weeks (% of initial weight)	91.0	2.9	90.2	5.8	87.3	6.1	.006[c]
"Happy" weight after 16 weeks (% of initial weight)	87.1	5.0	87.2	6.2	83.4	6.7	.011[c]
Impact of weight							
Work[e]	4.68	0.5	4.58	0.5	4.25	0.7	.007[c]
Health[e]	4.19	0.4	4.18	0.4	3.97	0.4	.030[c]
Self-motivation	3.80	0.6	3.60	0.5	3.39	0.5	.006[d]
Self-esteem/self-concept	9.15	1.0	8.61	1.6	8.05	1.8	.008[c]
Exercise barriers—*obstacles*	2.53	0.5	2.77	0.7	2.79	0.6	.128
Exercise self-efficacy—*making time*	3.99	0.5	3.87	0.6	3.76	0.5	.197
Body size dissatisfaction	3.14	1.2	2.94	1.0	3.91	1.3	.002[c]

[a] Unadjusted significance values for one-way analysis of variance (see text for Holm's adjusted *p* values).
[b] Calculated after 4-months; post hoc analysis (Tukey-HSD test).
[c] Tertile 3 different from tertiles 1 and 2 (1 and 2 not different).
[d] Tertile 1 different from tertile 3 only. For psychosocial variables, unless noted otherwise, a higher score indicates a higher value for the characteristic being measured.
[e] Higher score indicates a higher impact of weight on quality of life.

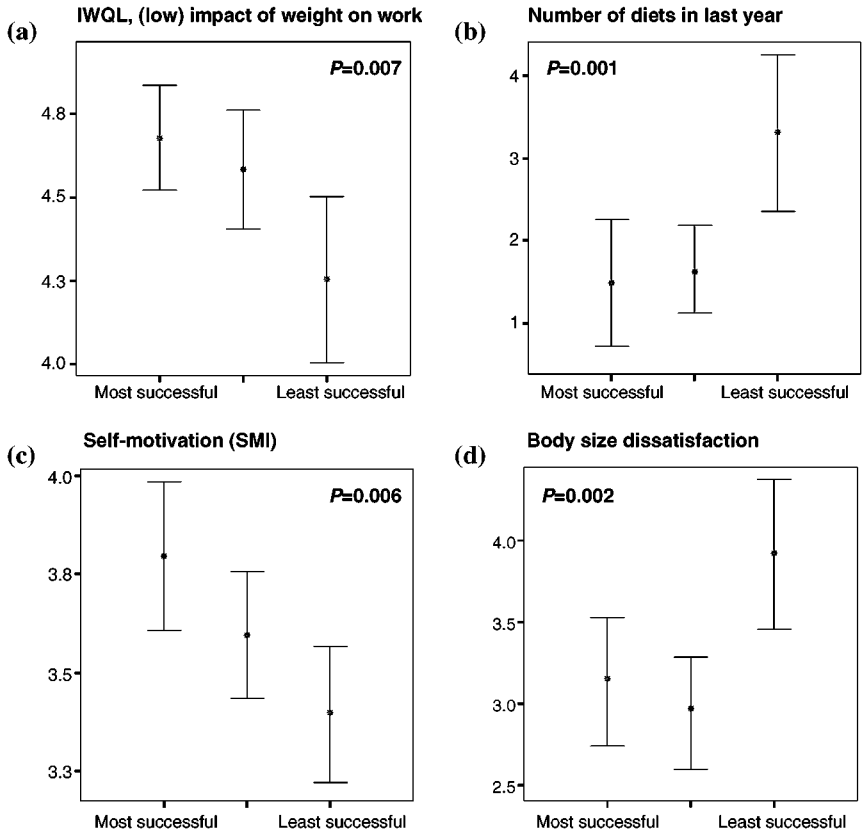

Fig. 2. Scorers for four baseline variables distinguishing tertiles of weight loss success. Errors bars show the mean and 95% confidence interval. *P* for ANOVA. In panel *a*, high scores indicate a lower perceived impact of weight on work.

least successful individuals into the correct group was 62.2% (chance probability would be 33.3%). Based on these classifications, subjects predicted to end the study within the most successful group had a probability of less than 11% of finishing within the least successful tertile. In contrast, women predicted to finish among the least successful third had a chance of misclassification into the opposite third (most weight loss) of about 16%.

DISCUSSION

Two unique features of this study were the comprehensive psychometric battery, covering a wide array of areas identified as potentially relevant

Table V. Classification Results for Discriminant Function Analysis (Whole Sample; $n = 112$)

		Predicted group membership			
		Tertile 1	Tertile 2	Tertile 3	Total
Count	Tertile 1	23	10	4	37
	Tertile 2	16	12	10	38
	Tertile 3	6	8	23	37
%	Tertile 1	62.2	27.0	10.8	100.0
	Tertile 2	42.1	31.6	26.3	100.0
	Tertile 3	16.1	21.6	62.2	100.0

Note. Tertile 1—most successful group; tertile 3—least successful group. Predicted group membership cells indicate the number of cases classified in the correct tertile (when tertiles match) and incorrectly classified in one of the two incorrect tertiles (no match). Variables in the discriminant function: years at current weight, weight loss >4.5 kg in previous 2 years, "acceptable" weight outcome evaluation, self-motivation, and body size dissatisfaction.

to weight management, and the prospective design. With the exception of dieting/weight history, all other variables were measured using previously validated psychometric instruments. There was considerable variation in weight loss, providing a suitable database for studying factors associated with success. For the least successful subjects, a higher number of diet attempts and recent weight losses, higher body dissatisfaction, more stringent weight outcome evaluations, higher perceived impact of weight on work, and lower self-motivation were observed, in comparison to more successful participants.

Recent and repeated diet attempts and body size dissatisfaction, two of the strongest predictors of weight loss in this study, have been previously shown to predict BMI changes in overweight men and women. Kiernan *et al.* (1998) found that, along with program type, these two variables were the only two independent factors capable of discriminating successful from unsuccessful participants in a 1-year weight loss program. Despite methodological differences between the studies, these results suggest that the two factors may be consistent predictors of success in overweight subjects entering a weight management program.

In this study, measures of eating self-efficacy were not predictive of weight loss. Eating self-efficacy was a significant predictor of weight loss in other (Edell *et al.*, 1987; Prochaska *et al.*, 1992) but not all (Dennis and Goldberg, 1996; Fontaine *et al.*, 1997) studies. We used the Eating Self-Efficacy Scale and the Weight Management Self-Efficacy scale, two of the most popular instruments, to measure this construct in the context of weight management (Rossi *et al.*, 1995). In fact, no eating behavior variable assessed in our study (self-efficacy, eating restraint, disinhibition, hunger, and binge eating) predicted weight changes. While changes in eating behavior

variables consistently accompany weight loss success (Clark *et al.*, 1991; Foster *et al.*, 1998), baseline scores appear to be poor predictors of weight change.

Unlike the eating-specific self-efficacy measures, the self-motivation inventory (SMI), a general scale measuring perceived confidence to achieve established goals, finish tasks initiated, and persevere in spite of difficulties, was consistently associated with outcomes in our study. Comparable results were found by Dennis and Goldberg (1996) in a sample of overweight (BMI = 31 kg/m^2), similarly aged women. They showed that baseline values on a new and more general self-efficacy measure, containing 20 items phrased very similarly to questions on the SMI, was positively associated with weight loss across the 9-month time interval. At baseline, subjects who scored higher on this scale also showed significantly higher self-esteem, less negative affect, and more realistic weight loss goals, results that corroborate our findings. Previous research has shown the usefulness of the SMI to predict weight changes (Clifford *et al.*, 1991) and that it is correlated with eating restraint, disinhibition, and hunger scores after weight loss (Bjorvell *et al.*, 1994). Despite some discordant data (Edell *et al.*, 1987), ours and other studies support the use of the SMI as a pretreatment assessment tool for weight management, which is also supported by the usefulness of this inventory to predict exercise adherence (Dishman and Ickes, 1981).

We found perceived impact of weight on work life and on health to be negatively correlated with subsequent weight loss. These scales are derived from a recently validated instrument assessing the impact of weight on different aspects of quality of life (Kolotkin *et al.*, 1997). Subjects who perceived their weight as a hindrance had more difficulty reducing body mass, independently of how much they weighed before the program. These findings are the first to be reported regarding associations of the Impact of Weight on Quality of Life (IWQOL) questionnaire with subsequent weight loss. Weight-related quality of life is negatively associated with BMI (Kolotkin *et al.*, 1995) and weight loss typically improves quality of life along several dimensions (Williamson and O'Neil, 1998). The present data suggest that lower quality of life perceived to be caused by weight may also curtail initial attempts at weight loss. An abbreviated version of the IWQOL–Lite is now available (Kolotkin *et al.*, 2001).

One of the most interesting findings in this study was that individuals who indicated larger weight losses as "acceptable" or "happy" weights (i.e., subjects who evaluated smaller weight losses as less satisfying) lost significantly less weight by the end of the program, compared with subjects with less stringent evaluations. The results were independent of baseline body weight. Using the same questionnaire we used, Foster *et al.* (1997) showed

that baseline body image and self-esteem were associated with "dream," "happy," "acceptable," and "disappointing" weight definitions (after controlling for BMI), with subjects with a more positive self-appraisal reporting less stringent weight outcome evaluations. Unrealistic expectations (or negative evaluations regarding realistic/achievable outcomes) are an important area of research in weight management and may be a useful marker for a profile characterized by more negative self-image/concept and higher perceived distress from one's weight, which were found to be detrimental for weight loss success in the present study.

A drawback of previous studies is the fact that high dropout rates, a common occurrence in weight loss trials, are usually not accounted for in statistical analyses, since follow-up data frequently cannot be collected. In our sample, about 20% of the subjects who began the study had dropped out by the intervention's end, a typical attrition rate (Wadden and Sarwer, 1999). When studying the continuum from success to nonsuccess in weight management programs, noncompleters are at the low end since they typically do not meet weight loss goals prior to dropping out. We found that noncompleters were already losing significantly less weight before they dropped out, even early in the trial (at 4 weeks), suggesting that important barriers were present in these subjects before they started. These data suggest that completers may be a biased sample in which to study predictors of weight loss, which may help explain why previous studies have failed to find more variables prospectively associated with weight loss (Allison and Engel, 1995). Including noncompleters in analyses may substantially improve the ability to detect predictors of outcomes. Future studies, with larger sample sizes, should also investigate whether subjects who drop out display unique psychosocial or other characteristics that predispose them for noncompletion.

Discriminant function and multiple regression analyses indicated that a combination of independent baseline factors better predict weight loss than any single variable. The amount of variance in weight loss predicted in this study was ~25% and classification results from discriminant function analysis showed that finishing the study in the least or the most successful group of weight loss could be predicted with ~62% accuracy (versus a 33% change probability). Using a comparable methodology, Kiernan *et al.* (1998) predicted membership in two categories of weight loss success with 63% accuracy (versus a 50% chance probability). These accuracy scores are encouraging but may still be low for widespread application. Further research and the inclusion of additional variables which may also predict weight loss success (e.g., family context, job situation, physical activity history), should yield improved readiness measures.

We believe that this study contributes to the body of knowledge in this area in three primary ways. First, several predictors of weight loss were identified, some of which were analyzed for the first time in this context. Second, it showed that including noncompleters in analyses could substantially improve the ability to predict outcomes. Finally, it indicated that categories of success can be predicted with moderate success using a combination of variables (see Tables IV and V) and may apply to future samples of middle-aged women.

One limitation of the current study was the large number statistical tests performed, which inflates the chance of type I error. We statistically adjusted for type I error inflation while minimizing type II error increases. Given the exploratory nature of this analysis (e.g., several variables being tested for the first time as predictors of weight loss), protecting against false-negatives is as important as protecting against false-positives. The fact that all prospective significant associations were found in the direction expected provides further evidence that relationships are not due to chance alone. A second limitation was the use of arbitrary cutoffs to define successful and nonsuccessful weight loss. Objective cutoffs are not currently available. Others have used absolute criteria, such as a given change in BMI units, to define success (Kiernan *et al.*, 1998) or have refrained from using cutpoints, choosing to analyze data only in a continuous fashion (Wadden *et al.*, 1992). Finally, findings from this study may apply only to middle-aged women undergoing a behavioral weight loss program.

Taken together, data from this study and previous research begin to describe the profiles of subjects more and least likely to succeed in short-term weight loss. In light of the relatively large percentage of subjects who do not lose minimal amounts of weight in spite of supportive circumstances, we believe that continuing to study short-term weight loss remains at least as critical as studying weight loss maintenance. This is also supported by the fact that short-term weight loss is a consistently good predictor of long-term success at least in clinical trials (Astrup and Rossner, 2000). In the current study, of the 112 women who began the study, 89 completed it and 23 dropped out. Assuming an arbitrary cutoff of (less than) one-third of the targeted weight loss as a marker of nonsuccess, 46 subjects (41%) either dropped out or were unsuccessful. Identifying individuals more likely to drop out and/or more likely to not meet weight reduction goals would positively impact future weight loss studies, avoid further frustration for persons not ready, and maximize the use of available resources. Several of the prospective associations we observed are reported here for the first time. They can be used to match programs to participants and to build a valid weight loss readiness questionnaire, two vital goals in the field of weight management.

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