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Sex differences in the relation of weight loss self-efficacy, binge eating, and depressive symptoms to weight loss success in a residential obesity treatment program

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Abstract

The aim of the current study was to examine whether weight loss self-efficacy, binge eating, and depressive symptoms predicted weight loss during treatment, and whether gender moderates these associations with prospective data from 297 participants (223 women and 74 men) enrolled in a residential obesity treatment program. Men reported higher initial levels of self-efficacy than women, whereas women reported greater pre-treatment levels of binge eating and depressive symptoms. Higher pre-treatment levels of weight control self-efficacy, binge eating, and depressive symptoms predicted greater weight loss in men, but not in women. Results suggest that certain psychological and behavioral factors should be considered when implementing weight loss interventions, and indicate a need to consider gender differences in predictors of weight loss treatment. Future research should seek to identify predictors of weight loss among women.

Keywords: Weight loss; Self-efficacy; Depression; Binge eating; Gender

1. Introduction

An estimated 65% of adults in the United States are currently overweight or obese (BMI $\geq$ 25.0 kg/m^2; Ogden et al., 2006). Given the extensive and expanding list of deleterious health outcomes associated with obesity (e.g., type II diabetes, coronary heart disease, osteoarthritis, gallbladder disease; Must et al., 1999), a growing number of individuals are seeking obesity treatment and much attention has been directed towards improving treatment outcomes. Identifying consistent predictors of weight loss during treatment has proven a challenging task (Martin, O'Neil, & Binks, 2002), yet it remains an important issue, particularly in light of evidence that initial, treatment-induced weight loss is a significant predictor of longer-term success (Stotland & Larocque, 2005). Recent research has examined several potential factors

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that may be associated with treatment-induced weight loss in an attempt to explain the substantial variability in outcomes and to improve treatment efficacy (Teixeira, Going, Sardinha, & Lohman, 2005). These have included factors such as demographic variables (e.g., age, initial weight), prior attempts at weight loss, outcome expectancies, perceived stress, and social support. However, identification of pre-treatment variables that could impede or facilitate treatment holds the greatest promise for refining or augmenting treatment programs. To date, research has focused on psychological and behavioral variables, such as depression and binge eating, that have been hypothesized to contribute to unsuccessful weight loss attempts, as well as those that are thought to improve outcomes, such as high self-efficacy regarding eating behaviors. However, none of these variables has been found to *reliably* predict weight loss success during treatment, which may indicate that these relations are moderated by other factors. Preliminary evidence suggests that these relations may differ for men and women (e.g., Linde et al., 2004); however, relatively little research has examined whether gender moderates the effects of these variables on weight loss success. Such information could help elucidate the nature of these associations and may account for some of the inconsistent findings observed in the literature.

1.1. Weight control self-efficacy

Weight control self-efficacy refers to one's perception that she or he can effectively engage in behaviors that will result in weight loss or maintenance (Bandura, 1977; Clark, Abrams, Niaura, Eaton, & Rossi, 1991). Self-efficacy beliefs may predict weight loss in obese populations because self-efficacy beliefs are hypothesized to play an important role in determining cognitive, affective, and behavioral responses following a discrepancy between standards and attainments (Bandura & Cervone, 1986). In other words, obese individuals with low weight control self-efficacy may feel daunted and become easily discouraged by perceived discrepancies between actual and desired weight, while those with high efficacy may tend to respond with intensified efforts and perseverance until they succeed. Some findings from cross-sectional studies indicate that higher self-efficacy is associated with greater weight loss (Dennis & Goldberg, 1996; Foreyt et al., 1995; Strecher, DeVellis, Becker, & Rosenstock, 1986), although not consistently so (Fontaine & Cheskin, 1997; Martin, Dutton, & Brantley, 2004; Prochaska, Norcross, Fowler, Follick, & Abrams, 1992). Studies that have examined this association prospectively provide additional evidence that self-efficacy expectations predict weight change following participation in a weight reduction program (Bernier & Avard, 1986; Jeffery et al., 1984; Linde, Rothman, Baldwin, & Jeffery, 2006; Stotland & Zuroff, 1991). Recent evidence suggests that self-efficacy may be more important during the initiation phase of behavior change, and less relevant to the long-term maintenance of these behaviors (Linde et al., 2006). One study examining the interaction of gender and weight control self-efficacy in predicting weight loss found that higher self-efficacy was predictive of greater weight loss for men, but not for women (Forster & Jeffery, 1986). In contrast, a recent investigation that examined the association between weight control self-efficacy and weight status separately by gender found that lower initial self-efficacy predicted poorer weight outcomes among women, but initial level of self-efficacy was not associated with weight loss in men (Linde et al., 2004). Further examination of this variable is needed to determine the nature of the relationship between self-efficacy predictions and weight loss success, and whether this relation is moderated by gender.

1.2. Binge eating

Binge eating is relatively common among obese individuals seeking weight loss treatment (de Zwaan, 2001; Fitzgibbon & Kirschenbaum, 1991; Marcus, Wing, & Lamparski, 1985), and is thought to predict less weight loss success during treatment because of the excess calories consumed during binges. In support, binge eating has been associated with poorer outcomes of obesity treatment (Agras, Telch, Arnow, Eldredge, & Marnell, 1997; Sherwood, Jeffery, & Wing, 1999; Yanovski, 2003), while reductions in uncontrolled binge eating during obesity treatment have been associated with greater weight loss (Stotland & Larocque, 2005). However, other studies have reported no association between binge eating and weight loss outcome (e.g., Cargill, Clark, Pera, Niaura, & Abrams, 1999; Gladis et al., 1998; Wadden, Foster, & Letizia, 1992), and some researchers have concluded that obese binge eaters respond equally well to behavioral obesity treatment compared to non-binge eaters (Wilson & Brownell, 2002).

Studies suggest that binge eating is equally common among men and women (Mazzeo, Saunders, & Mitchell, 2006; Striegel-Moore & Franko, 2003), yet there are some important gender differences, including greater frequency of bingeing, emotional eating, and dysphoria following binges among women (LaPorte, 1997; Reichborn-Kjennerud et al., 2003; Tanofsky, Wilfley, Spurrell, Welch, & Brownell, 1997) and greater prevalence of additional psychopathology among males who binge eat (Tanofsky et al., 1997). No studies examined whether gender moderated the relationship between binge

eating and weight loss during treatment. However, one study found that binge eating was not associated with weight loss outcomes at 6- or 12-month post-treatment for either men or women (Linde et al., 2004). Thus, it is unclear whether binge eating might be differentially related to weight loss outcomes for men and women.

1.3. Depression

Elevated rates of depression have also been observed among treatment-seeking obese individuals (Carpenter, Hasin, Allison, & Faith, 2000; Roberts, Kaplan, Shema, & Strawbridge, 2000), and several studies have supported the assertion that elevated depressive symptoms are associated with less success at weight loss (Bonnet et al., 2005; Wadden & Stunkard, 1987). This may occur because successfully following a weight loss program requires an individual to learn and invoke dietary rules that govern eating, and engage in elevated levels of activity. Symptoms associated with depression, such as decreased motivation, lethargy, and diminished concentration might therefore contribute to difficulty enacting these weight loss behaviors, and may result in poorer weight outcomes. However, in some studies, depression severity has failed to emerge as a significant predictor of weight loss (Cargill et al., 1999; Stotland & Larocque, 2005). Interestingly, some studies have found that baseline depressive symptoms actually led to *enhanced* weight loss following surgical and non-surgical obesity interventions (e.g., Averbukh et al., 2003; Sarlio-Lahteenkorva, Rissanen, & Kaprio, 2000), suggesting that psychological distress or impaired well-being may act as a motivator for weight loss. Research examining gender differences in the predictive effect of depression on weight loss indicate that greater severity of depression is associated with poorer treatment outcome, but only for women (Linde et al., 2004). However, no studies to date have specifically tested whether gender moderates this relationship.

Although prior studies have provided some preliminary support for several of the hypothesized predictors of weight loss success, this literature has certain limitations, including the use of cross-sectional designs and failure to control for initial weight and other relevant variables. Furthermore, despite preliminary evidence that the impact of these predictors on weight loss may differ for men and women, few prospective studies have specifically tested for interactive gender effects. Accordingly, the aims of the current study were to (1) better clarify the nature of the relations between each these factors and weight loss, and (2) test the moderating effects of gender on predictors of weight loss success using a prospective design and validated measures of these constructs in a sample of individuals participating in a controlled, residential obesity treatment setting. Based on prior findings, it was hypothesized that higher initial levels of self-efficacy, and lower levels of binge eating and depression would predict greater weight loss at post-treatment and that these associations would be moderated by gender.

2. Method

2.1. Participants

Participants were 297 treatment-seeking obese individuals (223 females and 74 males), ranging in age from 17 to 82 (mean age=47.63, SD=13.66), enrolled in the Structure House residential weight control and lifestyle change program. The sample was composed of 1% Native Americans, 2% Asians, 4% African Americans, 4% Hispanics, 82% Caucasians, and 3% other racial or ethnic backgrounds. Although we did not have data on educational attainment (a proxy for socioeconomic status) for the entire sample, data from a subset (N=76) of this sample indicated an average of 15.79 (SD=2.04) years of education.

2.2. Measures

2.2.1. Demographics

Gender, age, ethnicity, and educational attainment were assessed by questionnaire at baseline.

2.2.2. Height and weight

Body mass index (BMI=kg/m^2) correlates with direct measures of total body fat such as dual energy X-ray absorptiometry (r=.80–.90) and was used to reflect adiposity (Pietrobelli, Wang, & Heymsfield, 1998). Participants were weighed on a balanced standing scale without shoes while wearing light indoor clothing at pre- and post-treatment. Height was measured by staff at baseline and was used to calculate BMI at both assessments.

2.2.3. Weight control self-efficacy

The 20-item Weight Efficacy Lifestyle Questionnaire-Revised (WEL; Clark et al., 1991) was used to measure individuals' perceptions of their ability to control their weight by resisting eating in various situations. Respondents rate their confidence to resist eating on a 10-point scale ranging from 0 (*not confident*) to 9 (*very confident*), with higher scores indicating greater self-efficacy. The WEL is composed of five subscales that include situations related to availability (e.g., eating when food is readily available, such as at a party), negative emotions (e.g., eating when sad or anxious), physical discomfort (e.g., eating when fatigued or in pain), positive activities (e.g., eating while watching television or reading), and social pressure (e.g., declining food when others are encouraging eating). The WEL has been demonstrated to possess acceptable levels of internal consistency (Clark et al., 1991). Scale scores were computed by summing the four items that make up each of the five scales, and a total WEL score was also computed as an overall index of self-efficacy.

2.2.4. Binge eating

Binge eating severity was assessed with the Gormally Binge Eating Scale (BES; Gormally, Black, Daston, & Rardin, 1982). The BES is composed of 16 items designed to assess thoughts, feelings, and behaviors associated with binge eating. Each item contains 3–4 weighted statements corresponding to different degrees of binge eating severity. Respondents indicate which statement is most similar to their eating, and the measure is scored by summing the weighted scores for each item. The scale has been validated with treatment-seeking obese individuals and has demonstrated high internal consistency (Gormally et al., 1982). In addition, when compared with severity ratings based on interview data, the BES reliably discriminates between levels of binge eating severity (Gormally et al., 1982).

2.2.5. Depressive symptoms

Depressed mood was assessed with the Beck Depression Inventory (BDI-II; Beck, Ward, Mendelson, Mock, & Erbagh, 1961). The BDI is a 21-item self-report scale and each item on the BDI is rated from 0 to 3. The total score is based on the summation of the highest rating for each item, such that overall scores may range from 0 to 63. Depression scores ranging from 0 to 13 are considered "minimal", 14 to 19 are categorized as "mild", 20 to 28 are "moderate", and scores between 29 and 63 are considered "severe". The BDI has acceptable internal consistency ($\alpha = .73$ to .95), reliability (test–retest $r = .60$ to.90), and convergent validity with clinician ratings of depressive symptoms (mean $r = .75$; Barrera & Garrison-Jones, 1988; Beck, Steer, & Garbin, 1988). The BDI also has been found to discriminate depression from anxiety (Steer, Beck, Riskind, & Brown, 1986).

2.3. Procedure

Participants completed self-report questionnaires assessing demographic information, weight control self-efficacy, binge eating, and depression as part of their initial battery of evaluations prior to beginning treatment and again following the four-week core residential weight loss treatment program. In addition, direct measures of height and weight were taken by staff members at each assessment. The residential weight loss program adopts a comprehensive and multidisciplinary approach to weight loss emphasizing long-term lifestyle modification. Treatment consisted of an individualized restricted calorie diet (ranging from 1000 kcal/day to 2300 kcal/day, $M = 1250$ kcal/day, SD = 253) in which all meals were provided for participants, instruction in nutrition, exercise, and behavior modification strategies that promote weight loss, as well as participation in support groups and optional individual psychotherapy. The average duration of treatment was 27.13 (SD = 2.06) days. The Institutional Review Board of Duke University Medical Center approved this protocol and all participants gave written informed consent prior to their participation in this study.

3. Results

3.1. Preliminary analyses

Attrition analyses indicated that participants who did not complete post-treatment data did not differ significantly from those who provided data on any of the variables considered in this study at baseline, indicating that attrition should not introduce systematic bias that would compromise the generalizability of the findings.

3.2. Descriptive statistics

Mean body mass index was 43.07 (SD=10.02) for the overall sample at baseline, meeting criteria for Obesity Class III (NHLBI, 1998). Baseline BMI was significantly associated with pre-treatment levels of binge eating ($r=.12$, $p<.05$), but not with weight-related self-efficacy ($r=-.002$, *ns*) or depressive symptoms ($r=.03$, ns). Independent *t*-tests (for continuous variables) or Chi Square tests (for categorical variables) were performed to determine any gender differences on study variables at baseline. Results indicated that men and women did not differ in terms of age or ethnicity, but men had higher BMI at baseline ($t=6.92$, $p<.001$), and reported significantly higher levels of total weight control self-efficacy than women ($t=2.03$, $p<.05$). More specifically, men reported greater initial confidence in refraining from eating when experiencing negative affect ($t=-3.04$, $p<.01$) and during times of physical discomfort ($t=-3.34$, $p<.001$), but there were no significant differences on any of the other subscales for self-efficacy. Women reported significantly higher baseline levels of depressive symptoms ($t=-3.50$, $p<.001$) and binge eating ($t=-3.27$, $p<.001$). Means and standard deviations for each variable stratified by gender are presented in Table 1.

3.3. Changes in weight and weight loss predictors

The average weight change for the entire sample was −7.07 kg (SD=3.42), which represented a mean loss of 5.68% initial body weight during the 4-week core treatment program. For many individuals who are obese, achieving a 5–10% weight reduction is associated with meaningful improvements in health (e.g., glycemic control, blood pressure, cholesterol; Goldstein, 1992). A review of 48 randomized clinical trials suggests that low calorie diets typically result in an average weight loss of 8% of initial body weight over a period of 3 to 12 months (NHLBI, 1998). Men lost an average of 9.12 kg (SD=4.55) during treatment, with weight changes ranging from −28.21 kg to −0.18 kg, whereas women lost an average of 6.39 kg (SD=2.52), with weight changes ranging from −14.60 kg to −0.45 kg. As noted above, men entered treatment with higher average BMI compared to women, which likely accounts for the sex difference in weight loss during treatment. The Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults (NHLBI, 1998) recommend a rate of weight loss of 1–2 lb per week. The degree of weight loss in the current sample corresponds to an average rate of nearly 4 pounds per week. Given that this program is designed to help participants modify their lifestyles in a way that is sustainable long-term, this degree of weight loss is appropriate.

Self-efficacy increased during treatment in all five situational categories, with both men and women reporting significantly higher confidence in controlling their eating during negative emotions, when food is available, when under social pressure, during physical discomfort, and during positive activities at post-treatment (all *p*s<.001). By post-treatment, the gender differences in self-efficacy disappeared. Both binge eating ($t=17.0$, $p<.001$) and depression

Table 1
Means and standard deviation for baseline variables by gender

Variable	Women ($n=223$)		Men ($n=74$)	
	M	SD	*M*	SD
Age (years)	47.51	14.01	48.00	12.58
Height (cm)	64.78	2.47	69.85	2.98
Weight (kg)	113.28	28.46	147.09	37.79
T1 body mass index (kg/m^2)	41.90	10.37	46.64	11.46
T2 body mass index	39.54	10.03	45.50	10.78
WEL total	4.83	1.52	5.22	1.42
Negative emotions	3.67	2.06	4.55	2.18
Availability	3.96	1.79	4.31	1.74
Social pressure	5.55	2.06	5.53	1.79
Physical discomfort	5.44	1.98	6.23	1.69
Positive activities	5.53	1.75	5.50	1.70
Beck Depression Inventory	16.41	8.89	12.41	8.32
Gormally Binge Eating Scale	24.47	9.47	20.59	8.63
Weight change (kg) at 4 weeks	6.35	2.57	9.12	4.55
Percent weight change at 4 weeks	5.57	1.79	6.02	2.47

($t=17.0$, $p<.001$) decreased significantly during treatment. This was true for the entire sample and when men and women were analyzed separately.

3.4. Predictors of weight loss

The univariate relations between pre-treatment levels of each of the predictors and decreases in body mass index during treatment were first investigated in individual multiple regression models to gain an understanding of these relations that were not complicated by multicollinearity. These models examined the univariate relation between each predictor at pre-treatment and post-treatment body mass index for the entire sample, controlling for the effects of initial body mass index. The unstandardized parameter estimates, confidence intervals, standardized parameters, correlation coefficients, and p values from the univariate models are reported in Table 2.

Pre-treatment level of overall self-efficacy was a significant predictor of body mass index by the end of treatment ($B=-.09$, $p<.05$, $r=0.15$), controlling for initial body mass index. As expected, higher self-efficacy scores were associated with greater weight change. To provide greater insight into this relationship, each self-efficacy subscale was examined individually. Interestingly, this effect seemed to be primarily driven by initial confidence in managing eating during negative affect ($B=.06$, $p<.05$, $r=0.14$) and positive activities ($B=.08$, $p<.05$, $r=0.16$), as the relation between self-efficacy in the face of food availability, social pressure, and physical discomfort, and body mass index did not reach significance. Contrary to expectations, initial elevations in binge eating emerged as a significant predictor of lower post-treatment body mass index ($B=-.02$, $p<.001$, $r=-0.19$), controlling for initial body mass index. Similarly, elevated pre-treatment levels of depression significantly predicted decreases in post-treatment body mass index ($B=-.01$, $p<.05$, $r=-0.14$).

We also examined whether *change* in each of the variables during treatment was associated with body mass index. Results indicated that although self-efficacy across various situations significantly improved during treatment for both males and females, the change in overall level of self-efficacy was not significantly associated with body mass index at post-treatment. When examining the separate self-efficacy subscales, only improvements in self-efficacy for resisting eating during negative affect predicted lower post-treatment body mass index ($B=-.08$, $p<.05$, $r=-0.20$). In contrast, changes in binge eating ($B=-.02$, $p<.05$, $r=-0.19$) and depressive symptoms ($B=-.02$, $p<.05$, $r=-0.01$) during treatment were associated with body mass index at post-treatment, controlling for initial body mass index. The significant effects were small to moderate according to Cohen's (1988) criteria. We repeated these analyses using post-treatment body weight in kilograms as the dependent variable, controlling for initial body weight (kg), and the same pattern of results were found (i.e., all significant effects remained significant and all non-significant findings remained non-significant). Therefore, only the analyses using body mass index are reported.

3.5. Moderator analyses

To test whether gender moderated any of the univariate effects of the predictors, interaction terms were computed for gender and each of the T1 independent variables and added to the models. Variables were mean centered before computing interaction terms, and all analyses controlled for baseline body mass index. Results indicated a significant gender x self-

Table 2
Parameter estimates and confidence intervals from the univariate multiple regression models examining baseline predictors and post-treatment body mass index

Criterion variable and predictors	*B*	95% CI	*β*	*r*	*p*-value
WEL total	.08	.01–.15	.01	.14*	.021
WEL negative affect	.06	.01–.11	.01	.14*	.020
WEL availability	.05	−.01–.11	.01	.10	.101
WEL social	.03	−.02–.08	.01	.07	.257
WEL physical	.04	−.01–.09	.01	.09	.123
WEL positive	.07	.01–.13	.01	.14*	.017
Binge Eating Scale	−.02	−.03–.01	−.02	−.20***	.001
Beck Depression Inventory	−.02	−.03–.004	−.01	−.15**	.009

Note. *B* = unstandardized parameter estimates, CI = confidence interval; *β* = standardized parameter estimates; *r* = correlation coefficient; WEL = Weight Efficacy Lifestyle Questionnaire. All analyses controlled for baseline body mass index.
*$p<.05$, **$p<.01$, ***$p<.001$.

Table 3
Parameter estimates and confidence intervals from the multivariate multiple regression model examining baseline predictors and post-treatment body mass index

Criterion variable and predictors	*B*	95% CI	*B*	*r*	*p*-value
WEL total	.04	.20–.01	.01	.03	.660
Binge Eating Scale	−.04	−.07–.01	−.04	−.17**	.004
Beck Depression Inventory	−.03	−.06–.003	−.02	−.11	.079
Gender	.41	.164–.649	.02	.20***	.001
Gender × WEL	−.004	−.19–.18	.001	−.002	.970
Gender × BES	.04	.004–.07	.03	.11*	.027
Gender × BDI	.03	−.01–.06	.02	.09	.120

Note. *B* = unstandardized parameter estimates, CI = Confidence interval; β = standardized parameter estimates; *r* = correlation coefficient; WEL = Weight Efficacy Lifestyle Questionnaire; BES = Gormally Binge Eating Scale; BDI = Beck Depression Inventory. All analyses controlled for baseline body mass index.
*$p<.05$, **$p<.01$, ***$p<.001$.

efficacy interaction in the prediction of body mass index ($B=-.19$, $p<.05$, $r=-0.14$). Post-hoc analyses indicated that higher baseline level of self-efficacy was a significant predictor of weight change for men ($B=.25$, $p<.05$), but not for women ($B=.05$, ns). Results also indicated a significant gender × binge eating interaction ($B=.05$, $p<.001$, $r=0.24$). Post-hoc analyses revealed that higher baseline level of binge eating predicted greater weight loss for men ($B=-.06$, $p<.001$), but only marginally so for women ($B=-.01$, $p<.06$). Finally, there was a significant gender × depression interaction ($B=.05$, $p<.001$, $r=0.21$). Post-hoc analyses indicated that elevated baseline depressive symptoms were a significant predictor of greater reductions in body mass index for men ($B=-.05$, $p<.01$), but not for women ($B=-.01$, ns).

3.6. Multivariate analyses

Predictors that showed significant univariate relations, along with the significant interactions, were included in a multivariate regression model to assess the unique effect of each predictor controlling for the other predictors. This model tested whether T1 weight control self-efficacy, binge eating, depression, gender, gender × self-efficacy interaction, gender × binge eating interaction, and the gender × depression interaction predicted post-treatment body mass index, controlling for initial body mass index. The unstandardized parameter estimates, confidence intervals, standardized parameters, correlation coefficients, and *p* values from the multivariate model are reported in Table 3. The gender × binge eating interaction showed a significant unique relation to body mass index in the multivariate model, but the unique effects for gender × self-efficacy and gender × depression became non-significant. The significant effects were small in magnitude according to Cohen's (1988) criteria. The tolerance and VIF statistics indicated that multicollinearity was not a significant problem for any of the variables included in the analysis.

4. Discussion

The aims of this study were to examine whether a set of psychological and behavioral variables predicted weight loss success in a sample of treatment-seeking obese individuals using prospective data, and to explore gender differences in these predictors. Consistent with prior research, women reported lower initial levels of weight control self-efficacy, and greater binge eating and depressive symptoms than men (Forster & Jeffery, 1986; Linde et al., 2004), suggesting that these findings are relatively robust among obese, treatment-seeking populations. Initially high levels of weight control self-efficacy and depression predicted subsequent decreases in body mass index for men, but not for women. In addition, initial elevations in binge eating predicted decreases in body mass index at post-treatment for men, but only marginally so for women. The prospective design provides some assurance that the effects were in the hypothesized direction, and controlling for initial body mass index and the use of validated measures increases the confidence that can be placed in these findings.

4.1. Predictors of weight loss and moderating effects of gender

The interaction of weight control self-efficacy with gender suggests that the relation between initial self-efficacy and decreases in body mass index during treatment is stronger for men than for women. This is consistent with one other

study that found that higher self-efficacy at post-treatment was positively associated with resisting weight regain for men, but not for women (Forster & Jeffery, 1986). However, the current results contrast with other research suggesting that self-efficacy is a significant predictor of weight loss among women (Carels, Cacciapaglia, Douglass, Rydin, & O'Brien, 2003), but not among men (Linde et al., 2004). It should be noted, though, that the first study did not include men, and the latter study analyzed the effects separately for men and women and did not directly test whether gender moderated this relationship. It is possible that past success or failure with weight loss attempts may influence self-confidence in managing overeating, and despite increases in self-efficacy during treatment, one's confidence at the initiation of treatment is more predictive of weight loss. Women are more likely than men to report a history of frequent dieting (Mazzeo et al., 2006), which may be indicative of repeated diet failures that may undermine women's confidence in successfully managing their eating. It is also possible that men attending this program have not tried to lose a significant amount of weight previously, whereas the women may have attempted weight loss on their own previously. Unfortunately, we did not collect data on previous dieting history and were unable to examine this potential explanation. Another possibility is that, consistent with sociocultural standards and expectations, men may need to feel greater personal control in order to be successful, whereas weight loss success for women may be more dependent upon other factors, such as social support. Indeed, prior research has indicated that women are more successful at weight loss treatment when treated with their spouses, whereas men respond better when treated alone (Wing, Marcus, Epstein, & Jawad, 1991). Independent replication of this finding would be useful to increase our confidence that weight control self-efficacy differentially predicts weight loss during obesity treatment for men and women.

Binge eating emerged as one of the most potent predictors of decreases in body mass index during treatment, and again was moderated by gender. Interestingly, *higher* levels of binge eating predicted greater weight loss over the treatment period for men, but binge eating was only marginally associated with weight loss outcomes for women. This finding is consistent with previous studies that found that high baseline levels of binge eating were associated with greater weight loss (Gormally, Rardin, & Black, 1980; Gladis et al., 1998). Researchers have asserted that individuals who report more frequent binge eating prior to treatment may lose more weight than those who do not report binge eating because they experience a greater reduction in calorie intake as a result of decreased bingeing (Gladis et al., 1998). In the present study, it is likely that the highly structured, residential setting of the treatment program contributed to this effect because access to food and opportunities for bingeing were limited during the treatment period. Indeed, changes in binge eating during treatment significantly predicted reductions in body mass index in the current sample. This also accords with prior research indicating that early improvements in uncontrolled eating predict ongoing weight loss after the start of treatment (Stotland & Larocque, 2005).

It is curious, however, that this relationship was unique to men in the current study, particularly since women had higher initial levels of binge eating.[1] It is possible that other factors interact with gender and binge eating to influence weight change. For example, some researchers have suggested that the impact of binge eating on weight loss outcome may depend on the presence of depressive symptoms (Sherwood et al., 1999; Wilfley, Wilson, & Agras, 2003). That is, binge eating may predict poorer outcome of treatment for obesity, but only for individuals with elevations in depressed mood. Since men in this sample had relatively low levels of depressive symptoms, whereas women had significantly higher levels of depressive symptoms at treatment initiation, it is possible that this could account for the differential effects. Unfortunately, we did not have sufficient power to test for a three-way interaction in the current study, but this may be an area for additional exploration in future research.[2]

An interesting finding was that elevated depressive symptoms at treatment initiation predicted greater change in body mass index. Preliminary analysis of data from a small sample of participants in our residential obesity treatment program showed that higher initial depressive symptoms were associated with greater weight loss at post-treatment (Connell, Stout, Surwit, & Musante, 2005). In the current study, we confirmed this finding with a larger sample and found that the relation between depressive symptoms and change in BMI was moderated by gender. Though research findings have been mixed, the belief that greater depressive symptoms are associated with poorer weight loss is

[1] To examine whether pre-existing gender differences in initial levels of self-efficacy, depression, and binge eating might account for the observed gender differences, we matched a sub-sample of males and females on each of these variables and conducted parallel analyses. Results indicated that the gender × binge eating interaction remained significant ($B = .050$, $p < .05$, $r = 0.22$), as did the gender × depression interaction ($B = .043$, $p < .05$, $r = 0.18$) and gender × self-efficacy interaction ($B = -.202$, $p < .05$, $r = -0.15$).

[2] Although we did not have sufficient power to detect a three-way interaction, we tested the binge eating × depression interaction on change in body mass index separately for males and females. Results indicated that for females, the interaction approached significance ($B = 0.001$, $p = .096$, $r = 0.11$), but was non-significant for males ($B = 0.001$, $p = .653$, $r = 0.06$).

prevalent. Our findings, however, support the view that, at least for men, higher depressive symptoms promote greater weight loss during treatment. Previous research indicates differences in coping styles for men and women; whereas men employ more active coping strategies, women tend to use more passive strategies, such as rumination (Nolen-Hoeksema, 1987). Thus, depressive symptoms may elicit greater active attempts at coping and serve as a motivating factor for men. Elevated depressive symptoms were not related to change in body mass index for women, although recent research found that depression was a significant negative prognostic indicator for women trying to lose weight (Linde et al., 2004). This may only apply, however, to relatively severe depressive symptoms, as the study by Linde and colleagues operationalized depression as having a prior diagnosis of depression from a health care provider and currently taking medication for depression. Thus, it is possible that depressive symptoms may impact weight loss differently for men and women differently, and this may depend on the severity of the symptoms. Further, it is also possible that taking antidepressant mediation influenced the degree of weight loss achieved in the earlier study. Further research should investigate this possibility.

4.2. Limitations

When interpreting the findings, it is important to consider the limitations of this study. First, some of the apparent gender differences may have resulted from the uneven sample sizes, although it is curious that the lack of significant associations occurred for women. Additionally, this was a highly educated, predominantly Caucasian sample, which may limit the generalizability of our results to other ethnic groups. Second, although the use of prospective data can provide information regarding temporal sequencing, and represents a significant strength of the study, third-variable explanations cannot definitively be ruled out. Third, we relied on self-report questionnaires for our predictor variables. However, individuals are generally considered the best reporters of their own internalizing symptoms as well as behaviors that may be secretive, such as binge eating. Furthermore, direct measures of height and weight were used for the primary outcome (body mass index), which cannot be distorted by participants.

4.3. Implications and future directions

The current findings highlight the importance of examining the role of gender in predictors of weight loss treatment. Our results also indicate that further research is needed to identify significant predictors of weight loss during treatment for women, given that none of the variables were predictive of change in body mass index among women. In addition, it is possible that the effects of some of the predictors may be moderated by other, unexamined risk factors. Finally, a more diverse sample would allow researchers to examine whether other factors, such as ethnicity or age, may moderate the effects of these predictors on weight change. Continued attempts to elucidate how gender and other individual difference factors interact to predict treatment success would help clinicians target those individuals who are likely to benefit from treatment, and suggest different or supplementary interventions for individuals who are less likely to succeed with traditional approaches.

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