BRIEF REPORT

Weight Bias Internalization and Long-Term Weight Loss in Patients With Obesity

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Abstract

Background The relationship between weight bias internalization (WBI) and long-term weight loss is largely unknown.

Purpose To determine the effects of weight loss on WBI and assess whether WBI impairs long-term weight loss.

Methods One hundred thirty-three adults with obesity completed the Weight Bias Internalization Scale (WBIS) at baseline, after a 14-week lifestyle intervention in which they lost ≥ 5 per cent of initial weight, and at weeks 24 and 52 of a subsequent randomized controlled trial (RCT) for weight-loss maintenance (66 weeks total). Linear mixed models were used to examine the effects of weight loss on WBIS scores and the effects of baseline WBIS scores on weight change over time. Logistic regression was used to determine the effects of baseline WBIS scores on achieving ≥ 5 and ≥ 10 per cent weight loss.

Results Changes in weight did not predict changes in WBIS scores. Baseline WBIS scores predicted reduced odds of achieving ≥ 5 and ≥ 10 per cent weight loss at week 24 of the RCT (p values $< .05$). At week 52, the

interaction between participant race and WBIS scores predicted weight loss ($p = .046$) such that nonblack (but not black) participants with higher baseline WBIS scores had lower odds of achieving ≥ 10 per cent weight loss (OR = 0.38, $p = .01$). Baseline WBIS scores did not significantly predict rate of weight change over time.

Conclusions Among participants in a weight loss maintenance trial, WBI did not change in relation to changes in weight. More research is needed to clarify the effects of WBI on long-term weight loss and maintenance across race/ethnicity.

Clinical trials registration ClinicalTrials.gov identifier NCT02388568.

Keywords Obesity • Weight bias internalization • Weight loss • Weight stigma

Introduction

Weight bias internalization (WBI) occurs when individuals with obesity apply negative weight stereotypes to themselves and devalue themselves due to their weight (i.e., self-stigma) [1]. WBI consistently correlates with greater symptoms of depression, anxiety, and disordered eating [2]. WBI is also associated with reduced engagement in weight-related health behaviors, such as dietary adherence and physical activity [3–5]. Impaired engagement in health behaviors, along with the potential physiological stress of self-stigmatization, have been proposed as mechanisms underlying observed associations between WBI and cardiometabolic risk factors, such as metabolic syndrome [6].

Researchers and practitioners have called for greater attention to WBI in obesity treatment settings [7], but little is known about how weight loss itself may affect WBI. Some studies have shown small reductions in WBI following completion of short-term healthy eating or weight management programs [8–10], although one of

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these studies found no significant association between changes in weight and WBI [9]. Weight loss is associated with modest improvements in psychological outcomes such as self-esteem [11, 12] and could reduce self-disparagement due to weight. In addition, persons who lose weight may receive positive feedback from others and experience fewer instances of weight-based stigmatization and discrimination, which could reduce WBI. On the other hand, engaging in weight loss treatment may reinforce weight-biased assumptions (e.g., that weight is entirely within an individual's control [13]) and highlight the importance of one's weight and shape, which could serve to maintain or increase WBI. Furthermore, on average, patients regain one-third of their lost weight within a year following lifestyle interventions [14]. This weight regain can be demoralizing and, even if WBI were initially reduced by weight loss, could lead to subsequent increases in self-devaluation due to weight.

The impact of WBI on weight loss is also unclear. One study found less weight loss following bariatric surgery among patients with higher baseline levels of WBI [15], and another found that, cross-sectionally, higher WBI was associated with lower odds of reporting successful weight loss maintenance [16]. However, another study found no significant effects of self-devaluation (due to weight) on weight loss following a 3-month Internet-based program [17]. Prior research has also found lower levels of WBI among black versus white adults with obesity [6], but the potential interaction effect of WBI and race/ethnicity on health outcomes (including weight loss) has not been tested.

The current study sought to clarify the relationship between weight loss and WBI. First, we examined the effects of long-term weight loss on WBI. We hypothesized that patients who lost more weight would show greater reductions in WBI. Second, we hypothesized that higher baseline WBI would be associated with smaller long-term weight losses. We also conducted exploratory analyses including participant race as a potential moderator in the relationship between WBI and weight loss.

Methods

The current study represents a secondary analysis of a prior trial [18]. Participants were 137 adults with obesity who were enrolled in a long-term study of the effects of lorcaserin on weight loss maintenance. Inclusion criteria included being age 21–65 years and having a body mass index (BMI) of ≥ 33 and ≤ 55 kg/m² (or ≥ 30 kg/m² and an obesity-related comorbidity). Exclusion criteria included having a serious medical condition, current substance abuse, current major depression or use of antidepressants, active suicidal ideation, a history of suicide attempts, or psychiatric hospitalization within the past

6 months [18]. Informed consent was obtained from all individual participants included in the study.

Participants completed a 14-week low-calorie diet (LCD) program, which consisted of 90-min, weekly group meetings and prescription of a 1000–1200 kcal/day structured diet with meal replacements [19]. Participants who lost ≥ 5 per cent of their initial body weight during this 14-week program were then randomized to a 52-week trial of lorcaserin (a selective serotonin 5-HT_{2C} agonist) versus placebo for weight loss maintenance. Thus, participants were in treatment for a total of 66 weeks. The present study only reports findings for participants who successfully lost ≥ 5 per cent of their weight and were randomized to treatment. (Baseline WBI did not predict odds of being randomized into the maintenance trial.) Participants continued to attend a total of 16 group sessions (some of which were held by teleconference) over 52 weeks and were given calorie goals of 1200–1500 kcal/day for those who weighed <250 lb (113.4 kg) and 1500–1800 kcal/day for those ≥ 250 lb. Participants also were instructed to increase their physical activity to 225 min/week. The study protocol was approved by the university's institutional review board, and a data and safety monitoring board provided trial oversight [18].

Study Outcomes

Participants reported their age, gender, and race at the initial screening visit. Height (using a wall-mounted stadiometer; Veeder-Root, Elizabethtown, NC) and weight (on a digital scale; Detecto, model 6800A) were measured in duplicate at the screening visit. Weight was again measured at baseline and week 14, as well as at weeks 24 and 52 of the weight loss maintenance randomized controlled trial (RCT). Questionnaires, which included the Weight Bias Internalization Scale (WBIS), were also administered at these four assessment periods. The WBIS is a widely used, validated scale [1, 20, 21] that assesses the internalization of negative weight stereotypes and self-devaluation due to weight. The scale consists of 11 items scored on a 1–7 scale, with higher average scores signifying greater WBI (Cronbach's $\alpha = 0.84$).

Statistical Analyses

Analysis of variance was used to test for differences in WBI by treatment condition. Linear mixed models were used to examine the effect of weight change on WBI over time. Appropriate model shape and variance/covariance structure were selected using model fit criteria (–2 log likelihood), resulting in a quadratic model with variance component structure. Height and treatment condition were included as covariates, along with demographic characteristics (age, gender, and race) that have been found in prior research to be associated with WBI [22]

and weight loss [23]. Race was also tested as a moderator (in interaction with WBIS scores).

For secondary analyses, logistic regression models that controlled for demographic characteristics, baseline BMI, and treatment condition were used to determine the effects of baseline WBIS scores on the odds of achieving ≥ 5 per cent weight loss at weeks 24 and 52 of the RCT (all participants had lost ≥ 5 per cent at the end of the 14 week LCD program), as well as ≥ 10 per cent weight loss at the end of the 14 week LCD program and at weeks 24 and 52 of the RCT (66 weeks total). An interaction term between race and WBIS scores was included in a second step of the regression analyses. Participants with missing weight loss data (i.e., noncompleters) were counted as not achieving ≥ 5 or ≥ 10 per cent weight loss. A piecewise linear mixed model was used to test the effect of baseline WBIS scores on weight change over time.

Results

Participant characteristics have been reported previously [18]. The majority of participants were black (68.6 per cent; 24.1 per cent white, 2.9 per cent Asian, 4.4 per cent multiracial/other) and female (86.1 per cent). Mean participant age was 46.1 ± 10.1 years, and mean BMI at baseline was 40.8 ± 5.9 kg/m². At week 14, participants lost an average of 9.3 ± 2.9 per cent of initial weight (10.7 ± 4.0 kg). At week 52 of the weight loss maintenance RCT (i.e., 66 weeks total), lorcaserin-treated participants maintained an average loss of 7.8 ± 0.8 per cent of initial body weight (9.4 ± 0.9 kg), as measured from the start of the LCD program, compared with 6.6 ± 0.9 per cent (7.5 ± 1.0 kg) for those on placebo. As previously reported [18], lorcaserin-treated patients achieved a greater weight loss at week 24 of the RCT than participants who received placebo (11.7 vs. 8.4 per cent of initial body weight, $p < .01$), but no significant differences were found at week 52 ($p = .32$). No significant

differences between groups were found for WBIS scores at any time point, or for WBIS change scores from baseline to week 52 of the RCT. Data were thus collapsed across intervention groups, though treatment condition was included as a covariate.

A total of 133 participants completed the WBIS at baseline (scores for 8 participants were prorated; 4 participants with no baseline data could not be included in the analyses). In the linear mixed model predicting change in WBIS scores, weight change did not have a significant effect on change in WBI over time: weight $\times$ time $b = -6.96 \times 10^{-5}$, $SE_b = 0.0001$, $p = .54$; weight $\times$ time² $b = 3.35 \times 10^{-6}$, $SE_b = 2.93 \times 10^{-6}$, $p = .25$. (The effect of percent weight change on WBI, controlling for baseline BMI rather than height, was also tested and showed no significant effects.) Race did not significantly interact with WBIS scores or time. Overall, WBIS scores decreased by 0.40 points ($SD = 0.92$) from baseline to week 52 of the RCT (i.e., 66 weeks total): baseline $M = 3.69 \pm 1.14$ ($N = 133$), week 14 $M = 3.23 \pm 1.21$ ($N = 137$), week 24 of RCT $M = 2.97 \pm 1.26$ ($N = 105$), and week 52 of RCT $M = 3.23 \pm 1.32$ ($N = 90$).

Logistic regression results showed that, at week 24 of the RCT, higher baseline WBIS scores predicted 37 per cent reduced odds of achieving ≥ 5 per cent weight loss ($p = .012$) and 34 per cent reduced odds of achieving ≥ 10 per cent weight loss ($p = .022$; Table 1). This effect was not significant at week 52 for weight losses of ≥ 5 per cent ($p = .48$) or ≥ 10 per cent ($p = .13$), nor for ≥ 10 per cent weight loss at week 14 ($p = .22$). When the interaction between race and WBIS was added to the models, race moderated the relationship between baseline WBIS and odds of achieving ≥ 10 per cent weight loss at week 52 of the RCT (i.e., 66 weeks total; OR = 2.27, 95% CI = 1.01, 5.09, $p = .046$). Among nonblack participants, higher baseline WBIS scores were associated with 62 per cent lower odds (95% CI = 0.19, 0.80, $p = .01$) of achieving ≥ 10 per cent weight loss at week 52, whereas no effect of

Table 1 Odds ratios (and 95% confidence intervals) for effects of baseline weight bias internalization on $\geq 5\%$ and $\geq 10\%$ weight loss

Variable	$\geq 5\%$ Weight loss		$\geq 10\%$ Weight loss		
	Week 24 of RCT (38 weeks total)	Week 52 of RCT (66 weeks total)	End of 14 week LCD program	Week 24 of RCT	Week 52 of RCT
Weight bias internalization	0.63 (0.43, 0.90)*	0.89 (0.64, 1.24)	0.80 (0.56, 1.14)	0.66 (0.46, 0.94)*	0.75 (0.52, 1.09)
Female (vs. male)	0.80 (0.24, 2.64)	1.16 (0.39, 3.49)	0.31 (0.10, 0.98)*	0.70 (0.23, 2.18)	0.69 (0.21, 2.22)
Black (vs. nonblack)	0.57 (0.23, 1.43)	0.64 (0.27, 1.48)	0.59 (0.24, 1.42)	0.62 (0.26, 1.49)	0.48 (0.20, 1.15)
Age	1.02 (0.98, 1.06)	1.05 (1.01, 1.09)*	1.02 (0.98, 1.06)	1.02 (0.99, 1.06)	1.01 (0.98, 1.06)
Baseline BMI	0.97 (0.91, 1.03)	0.99 (0.93, 1.05)	0.93 (0.87, 1.00)*	0.99 (0.93, 1.06)	1.02 (0.95, 1.09)
Lorcaserin (vs. placebo)	2.56 (1.16, 5.62)*	2.13 (1.03, 4.43)*	N/A	3.22 (1.51, 6.87)**	1.03 (0.48, 2.22)

$N = 133$.

BMI body mass index; LCD low-calorie diet; RCT randomized controlled trial. All continuous predictor variables were centered at their means.

* $p < .05$; ** $p < .01$.

baseline WBIS scores on weight loss was found for black participants ($p = .94$). Baseline WBIS scores did not significantly interact with race to predict ≥ 5 or ≥ 10 per cent weight loss at any other time point.

The linear mixed model found no significant effect of baseline WBIS scores on rate of weight change at week 14 ($b = -0.002$, $SE_b = 0.02$, $p = .91$), or at week 24 ($b = 0.03$, $SE_b = 0.03$, $p = .23$) or 52 ($b = 0.002$, $SE_b = 0.01$, $p = .90$) of the RCT. Additionally, no significant interaction between race and WBI was found.

Discussion

This study provides needed data pertaining to the relationship between WBI and weight loss. In a sample of patients who lost approximately 7 per cent of their body weight during a 66-week weight management study, weight loss was not associated with reduction in WBI. These results stand in contrast to improvements in mood and quality of life that we and others have observed with a loss of 5%–10% body weight [19]. These findings suggest that weight loss alone is not sufficient to challenge internalized stereotypes and reduce self-devaluation due to weight.

Although weight loss was not associated with improvements in WBI, it also did not appear to exacerbate self-stigma. In other words, the process of losing weight did not appear to engender greater internalization of weight-based stereotypes or self-derogation due to weight. Reductions in WBI in our weight loss study were smaller than decreases reported in several pilot studies that tested psychological interventions to reduce WBI without weight loss [24–26]. For example, a recent study of an 8-week group cognitive-behavioral intervention for WBI among adults with obesity found that participants who received the intervention showed reductions of approximately 1 point on the WBIS (compared to the 0.4 point reduction reported in this study), which was significantly greater than changes in WBIS scores in a quasi-control group [26]. Thus, further development of adjunctive psychological interventions appears to be a more promising path to reducing WBI than is a sole focus on promoting weight loss.

Observed effects of baseline WBI on long-term weight loss were mixed. Baseline WBIS scores predicted reduced odds of achieving ≥ 5 or ≥ 10 per cent weight loss at week 24, but not at week 52 of the weight loss maintenance RCT. For non-black participants, higher baseline WBIS scores were associated with a 62 per cent reduction in the odds of achieving a weight loss of 10 per cent or more at week 52. However, this effect was not significant for black participants, nor at any other time points for ≥ 5 or ≥ 10 per cent weight loss. In addition, WBI did not predict the rate of weight change

when measured continuously. Consistent with prior research that has not found associations between WBI and weight loss in the short-term [17] but has found a relationship with weight loss maintenance [16], these findings might suggest a threshold effect such that initial WBI only predicts maintaining high amounts of weight loss in the long-term. Our ability to detect significant effects could also have been limited by lower variability in weight loss outcomes due to the fact that only participants who achieved a weight loss of at least 5 per cent at the end of the 14-week lifestyle intervention were included in the present study. Given that only some of our logistic regression models detected a significant effect of WBI, more research is needed to clarify the relationship between WBI and long-term weight loss across race/ethnicity and in different types of treatment-seeking samples. This can begin by incorporating the WBIS or other measures of WBI into large-scale weight loss trials as part of a standard battery of measures. As psychological interventions to reduce WBI continue to be developed, it will also be important to test their potential effects on enhancing long-term weight loss.

Investigating potential mechanisms by which WBI may affect weight loss and weight loss maintenance would also be informative. As with other types of internalized stigma [27, 28], WBI is associated with reduced self-efficacy—or confidence in one's ability to pursue goals—particularly with regards to weight-related health behaviors, such as physical activity [3, 4]. Self-efficacy is a strong predictor of weight loss [29, 30] and has been shown to improve with interventions that target WBI [26]. Future studies may continue to include measures of self-efficacy to better understand this potential pathway from WBI to health behaviors and weight-related health outcomes.

Generalizability of our findings is limited by inclusion only of participants who lost ≥ 5 per cent of their weight. Strengths of the current study include a larger sample size and longer follow-up than other weight loss studies that have reported WBI as an outcome, as well as a racially diverse sample. The internalization of weight bias has received increasing empirical attention in recent years and has been shown to be a more robust predictor of negative mental and physical health outcomes than the experience of weight bias alone [31, 32]. Recent estimates suggest that more than 40 per cent of U.S. adults with overweight and obesity internalize weight bias, and levels of WBI are particularly heightened among those who are trying to lose weight [22]. Thus, targeting WBI—particularly in weight management settings—is emerging as a priority among other efforts to alleviate the burden of weight stigma and its associated mental and physical health consequences.

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Compliance with Ethical Standards

Authors' Statement of Conflict of Interest and Adherence to Ethical Standards R.L.P. discloses serving as a consultant for Novo Nordisk, as well as receiving grant support outside of the current work from Weight Watchers. T.A.W. discloses serving on advisory boards for Novo Nordisk and Weight Watchers, as well as receiving grant support, on behalf of the University of Pennsylvania, from Eisai Co and Novo Nordisk. A.M.C. discloses receiving grant support from Shire Pharmaceuticals, outside the current work. N.A. discloses serving as a consultant for Novo Nordisk. R.I.B. discloses serving as a consultant to Eisai Co. J.S.T. discloses serving as a consultant for Novo Nordisk.

Authors' Contributions R.L.P. was an interventionist for the clinical trial and held primary responsibility for: the conceptualization and design of this specific study; conduct of the statistical analyses; interpretation of the data; and writing of the manuscript. T.A.W. was responsible for the design and conduct of the clinical trial and contributed to: the conceptualization of this specific study; interpretation of the data; and editing the manuscript. A.M.C. served as a medical monitor in the clinical trial and contributed to the editing of the manuscript. O.W. was a research coordinator for the study and participated in editing the manuscript. N.A. was a medical monitor for the study and participated in editing the manuscript. R.I.B. was the study physician and participated in editing the manuscript. J.S.T. was an interventionist for the clinical trial, was responsible for organizing the trial database, and contributed to the statistical analyses, data interpretation, and editing of the manuscript.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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