

# The Role of Stigma in Weight Loss Maintenance Among U.S. Adults

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## Abstract

**Background** Challenges of maintaining long-term weight loss are well-established and present significant obstacles in obesity prevention and treatment. A neglected but potentially important barrier to weight-loss maintenance is weight stigmatization.

**Purpose** We examined the role of weight stigma—experienced and internalized—as a contributor to weight-loss maintenance and weight regain in adults.

**Methods** A diverse, national sample of 2702 American adults completed an online battery of questionnaires assessing demographics, weight-loss history, subjective weight category, experienced and internalized weight stigma, weight-monitoring behaviors, physical activity, perceived stress, and physical health. Analyses focused exclusively on participants who indicated that their body weight a year ago was at least 10% less than their highest weight ever (excluding pregnancy), the weight loss was intentional, and that attempts to lose or maintain weight occurred during the past year ( $n = 549$ ). Participants were further classified as *weight regainers* ( $n = 235$ ) or *weight-loss maintainers* ( $n = 314$ ) based on subsequent weight loss/gain. Data were collected in 2015 and analyzed in 2016.

**Results** Hierarchical logistic regression models showed that internalized weight stigma and subjective weight category made significant individual contributions to prediction of weight-loss maintenance, even after accounting for demographics, perceived stress, experienced stigma, physical health, and weight-loss behaviors. For every one-unit increase in internalized weight stigma, the odds of maintaining weight loss decreased by 28% (95% CI: 14–40%,  $p < .001$ ).

**Conclusions** Findings provide initial evidence that overlooked psychosocial factors, like weight stigma, may hinder weight-loss maintenance. Implications for addressing stigma in obesity-focused clinical interventions are highlighted.

**Keywords** Stigma · Bias · Obesity · Weight loss maintenance · Internalization

## Introduction

Obesity represents one of the greatest causes of preventable morbidity and mortality in the USA [1]. The high prevalence rates of obesity in recent decades have been paralleled with an abundance of studies and clinical trials aiming to identify effective weight loss interventions. This evidence has demonstrated outcomes of modest weight loss (e.g., 5–10% of body weight) through conventional behavioral and pharmaceutical interventions, which can have clinically significant benefits for improved health [2]. However, most people do not sustain weight loss over time, and weight regain is a frequent outcome [3, 4]. Furthermore, improvements in metabolic risk factors resulting from initial weight loss are lost once weight is regained, and even mild degrees of weight gain (e.g., 2–6%) can cause plasma lipids, blood pressure, fasting glucose, and insulin levels to return to baseline, or become worse [5]. Thus, preventing weight regain after initial weight loss has become a

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priority in obesity management, and the effectiveness of weight-loss interventions relies on the sustainability of weight-loss maintenance. As a result, there has been increasing emphasis on obesity management approaches that facilitate weight maintenance and prevention of weight gain, rather than a singular focus on weight loss (e.g., a “maintain do not gain” approach) [6]. Of note, weight maintenance is important for people of diverse body weight statuses; not just those with a high body mass index (BMI; kg/m<sup>2</sup>). Repeatedly, losing and regaining weight through intentional dieting (weight cycling) [7] is high in the general population and not limited to individuals with overweight or obesity [8]. While research has yielded mixed findings on the harmful consequences of weight cycling, evidence suggests that increased risks for metabolic and cardiovascular diseases resulting from weight cycling are present in health-weight populations [8]. Thus, finding approaches that help people maintain a healthy weight across diverse BMI statuses is an important objective more broadly for public health.

Research has identified specific health behaviors that facilitate long-term weight-loss maintenance [9], such as high levels of physical activity, low calorie and fat intake, high dietary restraint, eating breakfast daily, self-monitoring of food intake, and regular self-weighing [10]. However, the difficulties of maintaining long-term weight losses are well established and continue to present a significant obstacle in efforts to effectively prevent and treat obesity [11, 12]. People typically regain a third of their weight loss in the first year and often regain the rest within 3–5 years [11, 13]. Reasons for weight regain reflect a multitude of biological, environmental, behavioral, and psychological factors, which are not yet fully understood [14]. However, research examining predictors of weight regain suggest that decreased levels of physical activity, dietary restraint, frequency of self-weighing, and increased disinhibition are factors that play a role [15]. As a result, increasing research has explored potential psychosocial factors that may affect adherence to behavioral strategies that facilitate weight loss maintenance, such as social support, perceived stress, and depression [16]. Important research questions remain, and other psychosocial factors that may affect weight regain or maintenance have not been adequately studied, and are needed to obtain a more comprehensive understanding of the multiple predictors of weight-loss maintenance. This gap in the field presents an opportunity for social science disciplines to make novel contributions to this important public health issue [17].

A highly relevant and potentially important psychosocial barrier to weight-loss maintenance that is notably absent in existing research is weight-related stigmatization. Weight stigma refers to negative societal devaluation of people because of their excess body weight, and can lead to weight-based stereotypes (e.g., that people with obesity are lazy and lack willpower), prejudice, or overt forms of discrimination [18].

Several decades of research have documented consistent weight stigmatization toward individuals who have obesity in multiple domains of living, including weight-based inequities and prejudice in employment, educational institutions, health care, as well as stigmatization in interpersonal relationships and more broadly in the mass media [18]. Weight discrimination has been documented as the third most common form of discrimination among women and the fourth most common form of discrimination among men in the USA [19].

Evidence has demonstrated important links between weight stigmatization and resulting adverse health behaviors and outcomes, many of which have direct implications for weight-related health behaviors and weight gain [20]. For example, adults who experience weight stigma have increased risk of depression [21], psychological stress [22, 23], increased calorie consumption [24, 25], binge eating and maladaptive eating behaviors [26, 27], reduced physical activity [28], heightened physiological stress [29], and increased weight gain and obesity [30]. Preliminary research also suggests that weight stigmatization is associated with poorer weight loss treatment outcomes [31], and that clinical interventions focused on helping individuals adopt adaptive strategies to cope with weight stigma may facilitate weight loss [32, 33]. Internalization of weight stigma (blaming oneself for one’s weight, societal devaluation, and stigmatization) may be particularly detrimental, and is associated with eating pathology (such as binge-eating), reduced physical activity, psychological distress, and poorer weight-loss treatment outcomes [34–36]. These adverse health outcomes associated with weight stigma may help to explain recent, national longitudinal research demonstrating an increased risk of obesity and remaining obese over time among individuals who report weight discrimination [30, 37]. Importantly, these studies demonstrated that weight discrimination, but not other forms of discrimination, predicted future obesity and remaining obese over time, regardless of sociodemographic factors and baseline BMI.

In addition, people who perceive themselves to be overweight, regardless of their actual level of adiposity, show some of the same negative health outcomes as those who report increased weight stigma, including being at increased risk for weight gain [38] and eating more in response to social threats [25]. Thus, paradoxically, it may be that the more people believe they are overweight, the more difficult it is for them to maintain weight lost after a diet.

Taken together, this evidence provides a compelling need to assess weight stigma and self-perception of weight status in the context of weight-loss maintenance. Despite evidence that weight stigma contributes to increased psychological distress, food consumption, binge eating, reduced physical activity, and obesity, very limited research has examined weight stigma as a factor that may specifically influence weight regain or interfere with ability to engage in weight-loss maintenance

behaviors. To date, the two published studies that have examined associations between experienced stigma and weight-loss maintenance demonstrated contradictory findings, potentially due to the use of different measures (and time periods) of experienced weight stigma with different treatment-seeking samples (from different countries), making comparisons difficult [39, 40]. Thus, the role of experienced weight stigma for weight-loss maintenance remains unclear, and no research that we are aware of has studied internalized weight stigma in addition to experienced weight stigma in this context. To address these gaps in research, we aimed to examine the role of both experienced and internalized weight stigma as potential contributors to weight-loss maintenance and weight regain in a national sample of American adults. It was hypothesized that both experienced and internalized weight stigma would be associated with poorer weight-loss maintenance.

As a secondary aim, in addition to weight stigma we examined whether participants' subjective perceptions of their own body weight affect weight-loss maintenance. Recent evidence from nationally representative samples of adults in the USA and UK showed that people who perceived their own weight status as being overweight were at an increased risk of subsequent weight gain, regardless of baseline weight status and whether their weight perceptions were accurate or not [38]. In the current study, we hypothesized that people who categorized themselves as overweight—regardless of their actual weight—would be less likely to maintain weight loss. However, we made no predictions about whether this effect would remain once experienced and internalized stigma was taken into account.

## Methods

### Participants

A diverse, national sample of 3087 American adults were randomly drawn from a national survey panel administered by Survey Sampling International (SSI), which includes over two million active research respondents [41]. Online recruitment by SSI is derived from more than 3400 sources to achieve demographic and psychographic diversity within the online population. SSI carefully screens panelists, and employs validation processes that compare respondent demographic characteristics to multiple databases. Panelists are 18 years or older, and quotas were established for sex, income groups, and race, to approximate U.S. census characteristics. Exclusions were made if participants had missing data or improbable values on key variables such as height and/or weight ( $n = 312$ ), or for statistical outliers on these variables ( $n = 73$ ), resulting in a final sample of 2702 participants. The current study focused exclusively on participants in the sample who indicated that their body weight a year ago was at least 10%

less than their highest weight ever (excluding pregnancy in women) and that they had deliberately tried to lose weight. Further, participants whose highest weight BMI was classified as “underweight” ( $n = 66$ ) were not included in the analyses due to concerns about possible eating disorders. All participants signified that they had tried to lose or maintain their weight during the past year ( $n = 549$ ). Participants were then classified as either *weight regainers* ( $n = 235$ ) or *weight-loss maintainers* ( $n = 314$ ) based on whether or not they were able to keep weight off over the next year (see below).

### Measures

In July of 2015, participants completed an online battery of self-report questionnaires to assess demographic characteristics (height, weight, age, sex, race, ethnicity, education, income), weight-loss history, perceived stress, perceived physical health, subjective weight category, weight stigma, weight-monitoring behaviors (e.g., frequency of eating breakfast), and physical activity.

#### *Weight-Loss Maintenance Classification*

Participants were asked to report their current height and weight, their weight a year ago, and their maximum weight (excluding pregnancy) [42]. All participants who indicated that their body weight a year ago was at least 10% less than their highest weight ever were then classified as either *weight regainers* if they reported a gain of >5% of body weight from 1 year ago to their current weight or *weight-loss maintainers* if their current weight did not surpass 5% of their weight a year ago [43]. Only those participants who responded “yes” to the question “During the past year, have you done anything to try to lose weight or keep from gaining weight?” [44] ( $n = 549$ ) were included in these classified groups. BMI of participants was calculated and stratified using clinical guidelines from the Centers for Disease Control [45].

#### *Perceived Stress and Perceived Health*

Perceived stress was measured using a four-item perceived stress scale [46]. This measure asks participants to indicate the extent to which they have felt stress in the last month. Responses were measured on 0 (never) to 4 (very often) scales. The scale displayed adequate internal consistency in this sample (Cronbach's  $\alpha = .72$ ). Responses were summed to create a composite measure.

Self-perceived physical health was assessed with the physical health quality of life subscale of the World Health Organization Quality of Life Scale-Brief [47]. The 7-item subscale asked participants to rate their quality of life (e.g., ability to function in daily life activities) and satisfaction with health (e.g., capacity to work, sleep, access to health services) during

the preceding 2 weeks on a 5-point scale. Cronbach's  $\alpha$  in this sample is .83.

### *Weight-Loss Maintenance Behaviors*

Participants responded to four questions concerning how frequently they engage in specific behaviors that have been linked to weight-loss maintenance. Specifically, participants were asked how many days a week they eat breakfast (0 = never, 7 = every day) [42], how often they weigh themselves (1 = less than once a month, 5 = several times per day) [48], and two questions measuring the extent to which they monitor their diet (i.e., recording food and beverage intake, measuring and weighing food; 1 = never, 5 = every day) [49]. The two dietary monitoring questions—which were significantly correlated ( $r = .46, p < .001$ )—were combined into a single indicator of dietary monitoring.

The validated Godin Leisure Time Exercise Questionnaire [50] was used to assess the frequency that participants engage in leisure-time physical activity over a typical week. Participants were asked four questions to indicate how many times on average they engage in different types of light, moderate, or strenuous physical activity for at least 15 min in duration. The scoring formula for this measure weights strenuous activity more heavily than moderate and light activity, and higher scores indicate more weekly leisure activity.

### *Weight Stigma and Subjective Weight Category*

Weight stigma was measured in two ways: experienced weight stigma and internalized weight stigma. To gauge experienced weight stigma, participants were asked whether they had ever been teased, treated unfairly, or discriminated against because of their weight. These experiences were summed to create an experienced stigma scale that ranged from 0 (never experienced weight stigma) to 3 (experienced all three types) [51]. Internalized weight stigma was measured using the Modified Weight Bias Internalization Scale [52], which assesses the extent to which participants apply weight-based stereotypes to themselves and judge themselves negatively due to their body weight. In line with recent evidence on the psychometric properties of this measure [53], the first item was dropped to improve item-to-total correlation, resulting in 10 items, which were then averaged. Each item was rated on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). Cronbach's  $\alpha$  in this sample is .94.

To measure subjective weight category, participants were asked how they would describe their current weight status from the options of (1) “very underweight”, (2) “underweight”, (3) “just about right”, (4) “overweight”, and (5) “very overweight”.

## Results

### Data Analysis

All analyses were performed using IBM SPSS (version 24.0) [54]. A series of chi-square tests (see Table 1) and independent-samples  $t$  tests (see Table 2) were conducted to determine if the weight-loss maintenance groups differed on key variables of interest. Correlational analyses were performed to determine if the relationships between the variables of interest differed as a function of weight-loss maintenance group (see Table 3). Finally, hierarchical logistic regression models were conducted to determine which variables of interest predicted classification into weight-loss maintenance groups (see Table 4).

### Differences Between Weight-Loss Maintenance Groups

As shown in Tables 1 and 2, weight-loss maintainers differed from weight regainers on a number of demographic variables. Weight regainers were disproportionately more likely to be female, whereas weight-loss maintainers were relatively equally split between males and females. Compared to weight regainers, weight-loss maintainers were older, more educated, and had higher incomes. Weight-loss maintainers had higher year-ago BMIs, but lower current BMIs, compared to weight regainers. Finally, weight-loss maintainers reported less perceived stress and higher quality physical health, compared to weight regainers.

With regard to weight-loss behaviors, as shown in Table 2, weight-loss maintainers reported eating breakfast more frequently and engaging in more physical activity during leisure time than weight regainers, but no differences were observed between the groups with regard to frequency of dietary monitoring and self-weighing.

The weight-loss maintenance groups also differed with regard to internalized and experienced weight stigma and subjective weight category. Specifically, as shown in Table 2, weight regainers reported significantly more internalized and experienced weight stigma and higher subjective weight category compared to weight-loss maintainers.

### Correlations Within Weight-Loss Maintenance Groups

As shown in Table 3, partial correlations indicated similar relationships between the variables of interest for weight-loss maintainers and weight regainers, but with a few exceptions. Specifically, for both groups, more internalized weight stigma was related to more perceived stress, worse perceived physical health, less physical activity during leisure time, higher subjective weight category, and more experienced stigma. For weight-loss maintainers only, more frequency in eating breakfast was correlated with more dietary monitoring and

**Table 1** Sample characteristics for participants in weight-loss maintenance categories and total sample

	Weight-loss maintainers		Weight regainers		Total sample	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Sex**						
Women	170	54.1	154	65.5	324	59.0
Men	144	45.9	81	34.5	225	41.0
Education**						
Less than high school or GED	1	0.3	4	1.7	5	0.9
High school or GED	27	8.6	42	17.9	69	12.6
Vocational/technical school	15	4.8	8	3.4	23	4.2
Some college	87	27.7	77	32.8	164	29.9
College graduate	129	41.1	75	31.9	204	37.2
Post-graduate degree	55	17.5	29	12.3	84	15.3
Income						
Under \$25,000	41	13.1	41	17.4	82	14.9
\$25,000–\$49,999	70	22.3	65	27.7	135	24.6
\$50,000–\$74,999	76	24.2	51	21.7	127	23.1
\$75,000–\$99,999	61	19.4	36	15.3	97	17.7
\$100,000–\$124,999	20	6.4	20	8.5	40	7.3
\$125,000 or more	46	14.6	22	9.4	68	12.4
Race/Ethnicity						
White	220	70.1	146	62.1	366	66.7
Black or African American	28	8.9	34	14.5	62	11.3
Hispanic or Latino	42	13.4	41	17.4	83	15.1
Asian or Pacific Islander	18	5.7	10	4.3	28	5.1
Other	6	1.9	4	1.7	10	1.8
Current BMI category***						
Underweight	11	3.5	1	0.4	12	2.2
Normal	124	39.5	65	27.7	189	34.4
Overweight	112	35.7	70	29.8	182	33.2
Obese	67	21.3	99	42.1	166	30.2

\*Weight-loss groups differ on variable at .05 alpha level (chi-square test)

\*\*Weight-loss groups differ on variable at .01 alpha level (chi-square test)

\*\*\*Weight-loss groups differ on variable at .001 alpha level (chi-square test)

physical activity during leisure time—these variables were not correlated for weight regainers. However, higher subjective weight category was related to worse perceived physical health and more experienced stigma for weight regainers, but not for weight-loss maintainers. Finally, for weight regainers, both internalized and experienced stigma were related to more dietary monitoring and more self-weighing, but these relationships did not emerge for weight-loss maintainers.

### Predicting Weight-Loss Maintenance

As shown in Table 4, hierarchical logistic regression was used to determine key variables in predicting which participants were able to maintain their weight loss over the past year. The analysis included three separate blocks of variables: block

1 tested the predictive value of demographic characteristics (i.e., age, sex, race/ethnicity, education, income), perceived stress, perceived physical health, and year-ago BMI; block 2 tested behaviors that have been linked to sustained weight loss: eating breakfast, dietary monitoring, self-weighing, and level of physical activity; block 3 tested internalized weight stigma, subjective weight category, and experienced weight stigma.

As a set, the demographic variables in block 1 significantly predicted which participants were classified as a weight-loss maintainer,  $X^2(8) = 85.10, p < .001$ . The Nagelkerke R-square for Block 1 was .19, indicating that the combination of demographic variables, perceived stress, and perceived physical health accounted for approximately 19% of the variance in whether or not a participant was classified as a weight-loss maintainer. Participants' age, education, and perceived

**Table 2** Means and standard deviations for key variables in weight-loss maintenance categories and total sample

	Weight-loss maintainers		Weight regainers		Total sample	
	Mean	SD	Mean	SD	Mean	SD
Age***	46.1	16.2	37.1	14.3	42.2	16.0
Education***	4.5	1.1	4.1	1.3	4.4	1.2
Income*	3.3	1.6	3.0	1.5	3.2	1.6
Year-ago BMI**	27.2	5.6	26.0	5.3	26.7	5.5
Current BMI***	26.6	5.4	29.3	6.0	27.8	5.8
Perceived stress***	10.1	3.3	11.7	3.2	10.8	3.3
Perceived physical health***	70.8	17.9	62.4	20.4	67.2	19.4
Eating breakfast*	6.2	2.5	5.6	2.5	5.9	2.5
Dietary monitoring	1.6	1.1	1.6	1.0	1.6	1.0
Self-weighing	2.7	1.2	2.6	1.2	2.7	1.2
Physical activity**	37.4	13.0	34.2	12.0	36.0	12.7
Internalized weight stigma***	3.5	1.5	4.6	1.4	4.0	1.6
Subjective weight category***	3.6	0.7	3.9	0.6	3.7	0.7
Experienced weight stigma*	1.0	1.18	1.24	1.22	1.1	1.20

BMI body mass index, SD standard deviation

\*Weight-loss groups differ on variable at a .05 alpha level (*t* test)

\*\*Weight-loss groups differ on variable at a .01 alpha level (*t* test)

\*\*\*Weight-loss groups differ on variable at a .001 alpha level (*t* test)

physical health made significant, individual contributions to prediction. Specifically, odds ratios showed that for every additional year in age, the odds of being a weight-loss maintainer increased by about 3% (Wald = 18.70,  $p < .001$ ). For every one-unit increase in educational attainment, the odds of being a weight-loss maintainer increased by approximately 26% (Wald = 7.49,  $p = 0.006$ ). For every one-unit increase in

perceived physical health, the odds of being a weight-loss maintainer increased by 2% (Wald = 10.25,  $p = .001$ ).

As a set, the additional variables in block 2—weight-loss behaviors—did not significantly predict which participants were weight-loss maintainers,  $\chi^2(4) = 4.13$ ,  $p = .389$ . Based on the Nagelkerke R-square, the combination of variables in blocks 1 and 2 accounted for approximately 20% of the

**Table 3** Partial correlations controlling for participants' age, sex, race/ethnicity, education, income, and year-ago BMI

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Perceived stress	–	-.53***	-.20**	.03	-.02	-.20**	.49***	.08	.20***
2. Perceived physical health	-.47***	–	.17**	.02	.03	.26***	-.43***	-.03	-.22***
3. Eating breakfast	-.14*	.21**	–	.14*	.06	.20***	-.09	-.03	-.04
4. Dietary monitoring	.05	-.12	.03	–	.21***	.17**	-.06	-.02	.05
5. Self-weighing	.11	.00	-.01	.22***	–	.15**	.11	.08	.02
6. Physical activity	-.17*	.25***	.13	.22***	.15*	–	-.16**	-.04	-.05
7. Internalized weight stigma	.52***	-.32***	-.12	.14*	.17*	-.14*	–	.21***	.37***
8. Subjective weight category	.11	-.15*	.03	.07	.04	-.10	.30***	–	.03
9. Experienced weight stigma	.28***	-.27**	-.07	.16*	.16*	-.03	.43***	.17**	–

Above the diagonal = weight-loss maintainers, below the diagonal = weight-loss regainers

\*Significant at a .05 alpha level (Pearson)

\*\*Significant at a .01 alpha level (Pearson)

\*\*\*Significant at a .001 alpha level (Pearson)

**Table 4** Hierarchical logistic regression models predicting categorization as a Weight-Loss Maintainer

Variables	Block 1		Block 2		Block 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.03***	1.02–1.04	1.03***	1.02–1.05	1.04***	1.02–1.05
Women (vs. men)	0.72	0.49–1.06	0.76	0.51–1.12	1.05	0.68–1.63
White (vs. non-White)	1.14	0.93–1.39	1.15	0.94–1.41	1.25	1.00–1.56
Education	1.26**	1.07–1.49	1.24*	1.05–1.47	1.32**	1.10–1.59
Income	0.96	0.84–1.09	0.95	0.83–1.09	0.97	0.84–1.13
Year-Ago BMI	1.03	0.99–1.06	1.03	0.99–1.07	1.14***	1.09–1.20
Perceived stress	0.95	0.88–1.02	0.95	0.89–1.02	1.02	0.93–1.10
Perceived physical health	1.02***	1.01–1.03	1.02**	1.01–1.03	1.01	1.00–1.02
Eating breakfast	–	–	0.99	0.92–1.07	1.00	0.92–1.09
Dietary monitoring	–	–	1.04	0.86–1.26	1.02	0.83–1.26
Self-weighing	–	–	1.00	0.85–1.18	1.11	0.93–1.33
Physical activity	–	–	1.02	1.00–1.03	1.01	0.99–1.03
Internalized weight stigma	–	–	–	–	0.72***	0.60–0.86
Subjective weight category	–	–	–	–	0.24***	0.15–0.36
Experienced weight stigma	–	–	–	–	1.20	0.99–1.45

OR odds' ratio, CI confidence interval, BMI body mass index

\*Significant at a .05 alpha level (Wald)

\*\*Significant at a .01 alpha level (Wald)

\*\*\*Significant at a .001 alpha level (Wald)

variance, which is roughly the same amount of variance accounted for in block 1—indicating that the inclusion of the weight-loss behaviors did not improve the predictive value of the model. None of the four weight-loss behavior variables individually predicted whether or not a participant was a weight-loss maintainer.

As a set, the additional variables in block 3—internalized weight stigma, subjective weight category, and experienced weight stigma—significantly predicted which participants were weight-loss maintainers,  $X^2(3) = 81.22, p < .001$ . Based on the Nagelkerke R-square, the combination of variables in blocks 1, 2, and 3 accounted for approximately 36% of the variance in whether or not a participant was classified as a weight-loss maintainer—a considerable increase in variance accounted for over blocks 1 and 2. Two variables in this block made significant individual contributions to prediction. Specifically, for every one-unit increase in internalized weight stigma, the odds of being a weight-loss maintainer decreased by 28% (Wald = 12.48,  $p < .001$ ). For every one-unit increase in subjective weight category, the odds of being a weight-loss maintainer decreased by 76% (Wald = 41.65,  $p < .001$ ).

## Discussion

In light of the absence of research examining the role of weight stigma in sustaining weight loss, our study provides

initial evidence that this variable warrants research attention as a novel factor that may hinder weight-loss maintenance. Internalized weight stigma significantly predicted poorer weight-loss maintenance even after accounting for demographic characteristics, perceived stress, physical health and weight loss behaviors, which have been previously identified as important factors affecting weight loss maintenance. Our findings showed that for every one-unit increase in weight-stigma internalization, the odds of being a weight-loss maintainer decreased by 28%. Unexpectedly, with internalized weight stigma and subjective weight category controlled for, experienced stigma was not a significant predictor of weight maintenance. This finding is similar to a study by Latner and colleagues [40] who found that experienced stigma did not impede weight-loss maintenance, but contrasts with a recent study of adults in the German Weight Control Registry, for whom a history of experienced weight teasing in childhood predicted poorer weight-loss maintenance [39]. Other evidence has linked both experienced and internalized weight stigma to psychological distress and maladaptive and emotional eating behaviors, giving reason to hypothesize that both forms of stigma could interfere with weight loss maintenance. Our study findings suggest that regardless of encountering overt incidents of weight-based teasing, unfair treatment, or discrimination, it may be that internalized negative weight-based attitudes and self-blame are particularly detrimental for personal efforts to sustain weight loss. More research is

warranted to clarify and compare how experienced versus internalized weight stigma may differentially influence these outcomes. In particular, it would be informative to examine whether internalized weight stigma mediates the relationship between experienced weight stigma and weight loss maintenance outcomes or other health behaviors that increase vulnerability to weight regain.

Although little is known about the role of internalized weight stigma in the context of weight-loss maintenance, recent evidence indicates that it may be a stronger predictor of poor emotional health and reduced exercise behaviors than experienced weight stigma alone [55, 56]. Our findings align with this evidence, as internalized weight stigma was associated with higher perceived stress, higher subjective weight category, less physical activity during leisure time, and lower perceived physical health. It will be important for future work to identify which weight-loss maintenance behaviors are most strongly associated with internalized stigma, and whether these relationships are similar or different across population characteristics such as sex, race/ethnicity, age, and body-weight status.

Importantly, subjective weight category also made a significant individual contribution to the prediction of weight-loss maintenance in our study, even after accounting for multiple factors linked to sustained weight loss, further underscoring the notion that internalized views of oneself may have heightened salience in weight-loss maintenance. Our findings are consistent with a recent national study of adults showing that perceiving oneself to be “overweight” increased the risk of weight gain irrespective of accuracy of self-perceptions and baseline weight [38]. Our study similarly suggests that regardless of actual BMI, subjective identification with a particular weight category could be informative in understanding weight-loss maintenance. While self-perceptions about weight have received insufficient attention in the weight-loss maintenance literature, our findings highlight a need to empirically assess if, and how, higher subjective weight (whether accurate or not) is predictive of weight regain, and whether it is related to weight stigma. For example, experimental research has demonstrated that exposure to weight stigma leads women to consume more calories and feel less capable of controlling their eating if they perceive themselves to be overweight; these effects of weight stigma did not extend to women who did not view themselves to be overweight [25]. Thus, it will be important to identify what predicts self-perceptions of weight status, and mechanisms underlying the relationship between subjective weight category and weight-loss maintenance, such as emotional overeating and reactions to weight stigma. As internalized weight stigma was positively associated with subjective weight category in our study, continued research is warranted to clarify the relationship between these two variables and how they may interact to interfere with weight-loss maintenance.

While our study reflects an investigation of novel psychosocial factors primarily neglected in the field of weight-loss maintenance, several limitations should be noted. First, the self-reported nature of weight history, physical activity, and body weight could have introduced measurement error due to misreporting on these variables. However, evidence suggests that discrepancies between self-reported versus actual weight change over time are small [57, 58], and research has demonstrated good concordance rates between online self-reported weight and measured weight [59], increasing confidence in the online self-reported measurement approach in this study. Second, the Internet panel used in this study is not nationally representative; nevertheless, it reflects a national, diverse sample with characteristics such as race, sex, and body weight distributions that approximate national estimates [60, 61]. In light of potential adverse health consequences of weight cycling for individuals across different weight statuses, it will be important for continued research to examine the relationship between weight stigma and weight maintenance in weight-diverse samples. Third, this study relied on cross-sectional data, and only with longitudinal investigations can the directionality and nature of the relationship between internalized weight stigma, self-perceived weight, and weight-loss maintenance be clarified. As our primary aim was to examine experienced and internalized weight stigma as contributors to weight-loss maintenance, it will be important for future studies to thoroughly examine potential mechanisms. Finally, for this field of study to advance, several inconsistencies in existing literature should be reconciled. To date, variability in study designs (e.g., retrospective versus prospective research) and differences in how primary constructs are measured (e.g., weight loss maintenance, weight stigma) make it difficult to establish conclusions across studies. Concerted efforts to improve methodological consistency with clearly defined and comparable constructs will be better able to inform clear directions for future research.

## Conclusions

The difficulties of maintaining weight loss reflect a significant challenge. Most behavioral and psychological weight loss interventions yield, at best, only small improvements in weight outcomes [11], and our current society continues to reinforce obesity as a socially acceptable stigma [62, 63]. Our findings underscore the need to obtain a clearer understanding of the roles that weight stigma (both internalized and experienced) and subjective weight category play in sustaining weight loss, which could inform new interventions to be developed and tested during the maintenance phase of weight loss, where success rates are poor. It may be that addressing weight stigma as part of clinical interventions for obesity could improve health outcomes or help prevent weight regain, by helping

people adopt adaptive strategies to cope with the impact of the stigmatizing environment and emotional distress resulting from internalized bias [64]. This echoes calls for clinical interventions to move beyond the focus on “weight” to address the *psychological meaning* that people attribute to their own body weight [65]. Thus, increased research attention to self-perceived weight and weight stigma as relevant psychosocial factors in this field of study will advance understanding of the complex interaction of factors that facilitate, or impede, weight-loss maintenance and can help identify novel opportunities for intervention.

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#### Compliance with Ethical Standards

**Authors’ Statement of Conflict of Interest and Adherence to Ethical Standards** Authors Rebecca M. Puhl, Diane M. Quinn, Bradley M. Weisz and Young J. Suh declare that they have no conflict of interest.

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