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The Weight of Stigma: Cortisol Reactivity to Manipulated Weight Stigma

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Objective: Rates of weight-based stigmatization have steadily increased over the past decade. The psychological and physiological consequences of weight stigma remain understudied.

Methods: This study examined the effects of experimentally manipulated weight stigma on the stress-responsive hypothalamic–pituitary–adrenal axis (HPA) in 110 female undergraduate participants (BMI: $M = 19.30$, $SD = 1.55$). Objective BMI and self-perceived body weight were examined as moderators of the relationship between stigma and HPA reactivity.

Results: Results indicated participants' perceptions of their own body weight (but not objective BMI) moderated the effect of weight stigma on cortisol reactivity: $F(1,102) = 13.48$, $P < 0.001$, $\eta^2_p = 0.12$ (interaction 95% CI range [−2.06 to −1.44, −1.31 to −0.99]). Specifically, participants who perceived themselves as heavy exhibited sustained cortisol elevation post-manipulation compared with individuals who did not experience the weight-related stigma. Cortisol change did not vary by condition for participants who perceived themselves as average weight.

Conclusions: In the first study to examine physiological consequences of active interpersonal exposure to weight stigma, experiencing weight stigma was stressful for participants who perceived themselves as heavy, regardless of their BMI. These results are important because stress and cortisol are linked to deleterious health outcomes, stimulate eating, and contribute to abdominal adiposity.

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Introduction

Weight-based stigmatization is prevalent in the United States (1,2), manifesting in mistreatment across employment, healthcare, education, and interpersonal settings (3). Unlike other stigmatized populations, obese individuals do not receive in-group protection, facing negative stereotyping from other obese individuals (4) and in fact prefer out-group members (thin individuals) (5,6). Obese individuals, therefore, experience pervasive and unique stigma.

Given the high prevalence of overweight/obesity in the United States (7), understanding the psychological and physiological consequences of weight stigma is critical. Research indicates that psychological consequences of weight stigma include increased risk for depression, anxiety, and body dissatisfaction (8-12). However, a comprehensive understanding of weight stigma is incomplete without understanding its understudied physiological consequences—consequences that may create or exacerbate health outcomes. For example, independent of BMI, research implicates weight stigma in decreased exercise motivation (13,14), decreased subjective health (15), increased disease burden (15), increased caloric consumption (16,17), increased disordered eating (18), and increased blood pressure (19,20).

Here, we draw upon social self-preservation theory (21,22), which describes how socially evaluative threats cause activity in the stress-responsive hypothalamic–pituitary–adrenal (HPA) axis, ultimately resulting in secretion of the hormone cortisol. Cortisol is important in the context of weight stigma because it is linked with negative health outcomes (21), stimulates eating (23), and directly promotes abdominal adiposity (24). Cortisol also increases in response to physical activity, but research suggests this type of increase is not as harmful as increases in response to socially evaluative threat (25).

Weight stigma as a socially evaluative threat could be stressful and stimulate cortisol secretion, thereby increasing weight, abdominal adiposity, and consequently perpetuating stigma. Accordingly, cortisol secretion in response to stigma may partially explain negative health outcomes of experiencing stigma. In the sole study that examined cortisol in response to weight stigma, Schvey, Puhl, and Brownell (26) used second-hand

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Author contributions: M.S. Himmelstein conceptualized the study and A.J. Tomiyama oversaw all research activities. All authors contributed to the study design. Data collection and processing was supervised by A.C. Incollingo Belsky and A.J. Tomiyama. M.S. Himmelstein performed the data analysis and interpretation under the supervision of A.J. Tomiyama. All authors contributed to the manuscript and revisions. All authors approved the final version of the manuscript for submission.

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TABLE 1 Demographic comparisons between stigma and control conditions

	Control		Stigma				
	M	SD	*M*	SD	*df*	*t*	*P*
Age	19.45	2.47	20.02	5.95	107	−0.62	0.539
BMI	24.05	2.78	24.29	4.79	108	−0.31	0.760
Self-perceived weight	4.51	0.66	4.56	0.82	108	−0.31	0.758
	n		*n*		*df*	χ^2	*P*
Race/ethnicity					6	6.18	0.404
White	7		10				
Black	4		1				
Hispanic	12		11				
Native American	1		0				
Middle Eastern	1		1				
Asian	15		26				
Multiracial	7		13				

exposure to stigma by showing normal-weight and overweight female participants a neutral video or a video depicting weight stigma. They found sustained cortisol elevation, regardless of BMI, in the stigma video group compared with controls, whose cortisol decreased.

Prior weight stigma studies (16,17) suggest individuals need not be objectively overweight to experience negative consequences of weight stigma. Subjective construal research demonstrates that perceptions can be as important as objective realities (27), and subjective construal may be particularly relevant to weight. Although the BMI cutoff for overweight is 25, women consider themselves overweight at a BMI of approximately 23 (28). Thus, individuals may *construe* themselves as overweight and therefore perceive weight stigma. We therefore capitalize on self-perceptions of weight in addition to objective BMI in our study.

Using a novel weight stigma paradigm, we address three understudied areas. First, we examined cortisol reactivity as a consequence of actively experiencing weight stigma. Second, we examined self-perceived body weight and objective BMI to test differences in susceptibility to stigma. Finally, we designed a manipulation that exposed individuals to first-hand interpersonal weight stigma through rejection from a shopping activity; this is important because interpersonal rejection mirroring a real-world situation might produce a more powerful reaction than previously tested experiences of weight stigma (16,20,26). We hypothesized individuals in the weight stigma condition would experience sustained cortisol elevation compared with control participants, but expected the effect to be moderated by subjective (i.e., self-perceived) body weight. Specifically, we expected sustained cortisol elevation in the stigma condition only in individuals perceiving themselves as overweight, compared with subjectively normal weight individuals. Previous evidence (20,26) regarding the relationship between BMI, weight stigma, and physiological reactivity is mixed, and we therefore also tested objective BMI as a moderator. Furthermore, we hypothesized that any weight stigma effects would occur beyond any effects of basic negative affect. That is, we tested the effect of stigma *per se* rather than simply negative affect from the manipulation.

Methods

Participants

We chose undergraduate women ($N = 110$) for this study because women face higher levels of weight stigma and perceive themselves as overweight at lower levels of BMI compared with men (3,28). Undergraduates are also particularly susceptible to negative health behaviors accompanying weight stigma (e.g., unhealthy dieting) (29). Because weight stigmatization is implausible for participants perceiving themselves as thin, inclusion criteria included self-perception of weight as "average" or "heavy" during prescreening. Participants were non-smokers because smoking interferes with cortisol levels (30).

Demographics appear in Table 1. Age ranged from 17 to 57 ($M = 19.77$, $SD = 4.76$) with 95% between 17 and 22. Analyses yielded similar results regardless of whether the five outlying participants (aged 23–57) were included or excluded. We included them in our analyses but controlled for age.

Procedure

The University's Institutional Review Board approved all procedures, and all participants provided written, informed consent. All sessions occurred between 1300h and 1900h to control for diurnal cortisol variations. We instructed participants to fast and not exercise for 1 hour before participation (30). Participants could choose this study from those available to all students in the psychology subject pool. The listing read, "Participants are invited to complete a study aiming to assess qualities and activities of typical students. This study will involve completing confidential surveys and questionnaires. You may also have the opportunity to participate in a shopping activity."

Upon arrival, each participant was randomized to either the stigma or control condition (described below). After informed consent, a thin researcher (researchers'/confederates' BMI ranged from 16.3 to 21.1, $M = 19.30$, $SD = 1.55$) informed the participant that the study aimed to examine hormonal responses to shopping. Part of the lab was staged as a shopping area with clothing and music to bolster this cover story. The participant was told that she might get to participate in a group shopping activity using designer clothing. The participant then provided a baseline salivary cortisol sample, and her height and weight were measured.

The participant then entered a waiting area with a thin female confederate. When the researcher returned several minutes later, she brought the confederate into the hallway and said audibly, "Great news! You have qualified to participate in the group shopping activity. You can go across the hall to join the others and wait for instructions." The research assistant then returned and delivered one of the following manipulations.

Control condition. "Unfortunately, the group shopping activity is full now, and since you were the last to sign up, we can't include you in the activity."

Stigma condition. "Unfortunately, your size and shape just aren't ideal for this style of clothing and we really do want everyone to have fun and feel good. Plus, we want to return the clothing to the designer in good condition." The stigma condition script was designed to contain components of a stigmatizing event according to Goffman's framework (31), which specifies stigma as an abomination of the body and a blemish of individual character.

All participants were told "However, to receive your participation credit, we will have you do a virtual shopping trip and print your shopping bag. Come with me back to the other testing room so we can set you up to finish the study." The participant then completed psychosocial measures and an online shopping activity. Because cortisol changes take approximately 20–40 minutes to register in saliva (30), the participant provided the second saliva sample 30 minutes later. The researcher conducted a funneled debriefing to assess believability of the cover story. No participants guessed the true purpose of the study. The researcher fully debriefed the participants. No adverse events occurred.

Measures

Self-perceived body weight. Self-perceived weight was measured as an eligibility criterion for the study and during the laboratory session as a moderating variable using a single-item, "Please rate yourself on the following scale," with the following anchors: very thin, moderately thin, slightly thin, average, slightly heavy, moderately heavy, very heavy. In the departmental pre-test administered at the beginning of each academic quarter, participants rated themselves as average ($n = 73$), slightly heavy ($n = 34$), moderately heavy ($n = 2$), or very heavy ($n = 1$), $M = 4.37$, SD = 0.57. In lab, participants rated themselves as slightly thin ($n = 4$), average ($n = 54$), slightly heavy ($n = 43$), moderately heavy ($n = 7$), and very heavy ($n = 2$), $M = 4.54$, SD = 0.75. Given the small number in the outermost categories (four slightly thin, nine moderately heavy/very heavy) we collapsed self-perceived weight into average/thin ($n = 58$) versus heavy ($n = 52$). Examining self-perceived weight as a dichotomous versus ordinal variable yielded similar results.*

*The interaction among cortisol change, condition, and self-perceived body weight also emerged when examining self-perceived body weight as an ordinal variable: ($F(3) = 4.54$, $P = 0.005$; $\eta^2_p = 0.12$ (interaction 95% CI range [−2.98 to −1.44, −1.22 to −0.79]).

Negative affect. The state negative affect subscale of the Positive and Negative Affect Schedule (32) consisted of 10 items. Respondents indicated the extent to which they experienced a feeling/emotion at that moment (e.g., "irritable," "distressed") using a 5-point scale from 1 (not at all) to 5 (extremely). Scores ranged from 1 to 3.90 ($M = 1.53$, SD = 0.64). Cronbach's alpha was 0.90.

BMI. Trained researchers measured body weight using Tanita Professional Body Composition Monitor SC-331S. The scale displayed weight on a screen on a table (at waist level) next to the participant; researchers did not explicitly reveal or hide the number. Participant height was measured without shoes to the nearest 1/12 inch using a stadiometer. BMI ranged from 17.57 to 46.67 ($M = 24.19$, SD = 4.04). Participant BMI was underweight ($n = 1$, 0.9%), normal weight ($n = 74$, 67.3%), overweight ($n = 24$, 21.8%), and obese ($n = 9$, 8.3%).

Cortisol. Saliva samples collected via passive drool measured cortisol at baseline and 30 minutes post-manipulation. They were frozen at −20°C and batch assayed at Technical University of Dresden, Germany using chemiluminescence immunoassay. The inter-assay variability ranged from 4% to 7%. As is common (30), cortisol distribution was skewed (T1 skewness = 2.00 and T2 skewness = 3.37) and corrected via natural log transformation. There were no outliers in the log-transformed values. Raw cortisol values in μg/dl at T1 ranged from 0.05 to 1.22 ($M = 0.28$, SD = 0.18) and cortisol at T2 ranged from 0.06 to 1.27 ($M = 0.25$, SD = 0.20).

Results

Baseline differences

There were no demographic differences between conditions (see Table 1). An independent samples t-test indicated a difference in cortisol level at time 1 by condition among those perceiving themselves as average weight. Specifically, participants who reported an average self-perceived weight had lower cortisol before the manipulation in the control condition ($M = -1.61$, SD = 0.55) compared with the stigma condition ($M = -1.24$, SD = 0.59, $t(56) = -2.42$, $P = 0.019$, $d = -0.65$, 95% CI [−0.68, −0.06]). This occurred though the first saliva sample was taken before the stigma manipulation. Accordingly, below we conducted tests of our hypotheses to rule out the alternative explanation that any differences were driven by cortisol level at T1 in individuals with average self-perceived weight.

Control variables

We controlled for BMI when testing self-perceived weight as a moderator to isolate independent effects of self-perceived weight. To rule out the alternative explanation that any effects occurred from negative affect rather than stigma, we controlled for negative affect. We also tested whether negative affect differed by condition after the experimental manipulation. Participants displayed slightly more negative affect in the stigma condition ($M = 1.63$, SD = 0.69) compared with the control condition ($M = 1.40$, SD = 0.56), but the difference was marginal: $t(108) = 1.91$, $P = 0.059$, $d = 0.37$. We controlled for age because our data contained age outliers (see above). We note analyses yielded the same findings regardless of inclusion of covariates; all coefficients, P-values, and effect sizes with and without covariates appear in Tables 2 and 3.

TABLE 2 Repeated measures analysis of within-subjects effects on cortisol from time 1 to time 2 with and without covariates

	Analysis with covariates				Analysis without covariates			
	df	*F*	*P*	η^2_p	*df*	*F*	*P*	η^2_p
Cortisol	(1,102)	3.14	0.079	0.03	(1,106)	9.80	0.002	0.08
Cortisol * condition	(1,102)	0.03	0.874	0.00	(1,106)	0.18	0.674	0.00
Cortisol * subjective weight	(1,102)	1.12	0.293	0.01	(1,106)	0.01	0.914	0.00
Cortisol * condition * subjective weight	(1,102)	13.48	0.000	0.12	(1,106)	11.82	0.001	0.10
Cortisol * negative affect	(1,102)	0.28	0.601	0.00				
Cortisol * BMI	(1,102)	2.89	0.092	0.03				
Cortisol * age	(1,102)	0.64	0.426	0.01				

Self-perceived body weight interaction

We conducted repeated measures ANCOVA on cortisol change (T1 to T2) by condition (stigma versus control) and self-perceived weight (average versus heavy) controlling for BMI, negative affect, and age (see Table 2). A significant three-way interaction emerged among cortisol change, condition, and self-perceived weight, $F(1,102) = 13.48$, $P < 0.001$; $\eta^2_p = 0.12$ (interaction 95% CI range [−2.06 to −1.44, −1.31 to −0.99]).[1] To interpret the significant three-way interaction among cortisol change, condition, and self-perceived weight, we conducted two follow-up repeated measures ANCOVAs on cortisol change by condition separately for individuals who rated their self-perceived weight as average versus heavy; the *F* values were corrected to reflect the residual degrees of freedom for the entire sample, not only the subgroup. The condition by cortisol change interaction remained significant for individuals perceiving their weight as average, $F(1,102) = 7.32$, $P = 0.008$, $\eta^2_p = 0.12$ (interaction 95% CI range [−1.84 to −1.47, −1.39 to −1.05]), and heavy, $F(1,102) = 4.66$, $P = 0.030$, $\eta^2_p = 0.09$ (interaction 95% CI range [−2.05 to −1.76, −1.48 to −1.19]). This indicates self-perceived average and heavy individuals experienced sustained cortisol elevation in the stigma condition compared with controls.

In order to confirm the difference in cortisol level by condition at T1 among individuals perceiving themselves as average weight ($t(56) = -2.42$, $P = 0.019$, $d = -0.65$, 95% CI [−0.68, −0.06]) was not driving the three-way interaction among cortisol, condition, and self-perceived weight, we conducted a 2 × 2 ANCOVA on cortisol level at T2 by condition and self-perceived weight controlling for cortisol level at T1, age, negative affect, and BMI. This analysis confirmed that the weight stigma manipulation compared with the control condition led to sustained cortisol elevation regardless of baseline cortisol: $F(1,101) = 9.90$, $P = 0.002$, $\eta^2_p = 0.09$ (interaction 95% CI range [−1.95 to −1.62, −1.61 to −1.27]). Follow-up tests (*F* values were again corrected) indeed revealed participants perceiving themselves as heavy displayed more cortisol in the stigma condition compared with the control condition: $F(1,101) = 4.24$, $P = 0.040$, $\eta^2_p = 0.09$ (interaction 95% CI range [−2.02 to −1.72, −1.62 to −1.38]). No difference in cortisol by condition emerged for individuals perceiving themselves as average weight, $F(1,101) = 2.30$, $P = 0.130$, $\eta^2_p = 0.06$ (interaction 95% CI range [−1.84 to −1.64, −1.52 to −1.27]). These results indicate the significant change in cortisol level (T1, T2) by condition (stigma, control) among individuals who rated their weight as average, observed in the previous repeated measures ANCOVA, was driven by the difference in cortisol level at T1 compared with T2. That is, only participants perceiving their weight as heavy in the stigma condition (compared with control) experienced higher cortisol after the manipulation.

BMI interaction

Half the individuals who perceived themselves as heavy did not meet the BMI criterion for overweight (BMI ≥ 25 kg/m^2), indicating the

TABLE 3 ANOVA with and without covariates

	Analysis with covariates				Analysis without covariates			
	df	*F*	*P*	η^2_p	*df*	*F*	*P*	η^2_p
Time 1 cortisol	(1,101)	92.16	0.000	0.48	(1,105)	92.32	0.000	0.47
Subjective weight	(1,101)	0.30	0.586	0.00	(1,105)	0.09	0.766	0.00
Condition	(1,101)	0.08	0.784	0.00	(1,105)	0.00	0.945	0.00
Subjective weight * condition	(1,101)	9.90	0.002	0.09	(1,105)	8.10	0.005	0.07
Negative affect	(1,101)	0.20	0.659	0.00				
BMI	(1,101)	1.67	0.199	0.02				
Age	(1,101)	1.42	0.237	0.14				

Note: Cortisol level at time 1 was used as covariate in both analyses because the dependent variable is cortisol level at time 2.

stigma manipulation was physiologically stressful among individuals perceiving themselves as heavy regardless of objective BMI. We conducted repeated measures ANCOVA on cortisol change by condition and objective BMI category (normal versus overweight/obese) controlling for self-perceived weight, negative affect, and age. The analysis yielded no significant interaction effects $F(1,101) = 0.70$, $P = 0.405$, $\eta^2_p = 0.01$ (interaction 95% CI range [−0.52 to 0.50, −0.63 to −0.68]). Likewise, a 2x2 ANCOVA on cortisol at T2 by condition and BMI category (controlling for cortisol at T1, negative affect, age, and self-perceived weight) yielded no significant interaction between condition and BMI category: $F(1,100) = 0.73$, $P = 0.394$, $\eta^2_p = 0.01$ (interaction 95% CI range [−1.80 to −1.76, −1.51 to −1.50]).

Discussion

We used a novel paradigm to test cortisol reactivity after an active manipulation of interpersonal weight stigma. We found self-perceived body weight, but not objective BMI, moderated the relationship between weight stigma and cortisol reactivity, such that only those perceiving themselves as heavy showed significant sustained cortisol elevation after a weight-stigmatizing manipulation compared with non-stigmatized controls. Interpreted another way, those in the stigma condition perceiving themselves as normal weight appeared to return to their baseline cortisol level, whereas those who perceived themselves as heavy did not (Figure 1).

Because conflicting evidence exists (20,26) in relation to BMI and physiological reactivity, we hypothesized but did not find a difference in sustained elevation based on BMI. Schvey and colleagues (26) similarly found no moderating influence of BMI on cortisol reactivity to weight stigma. These findings underscore the importance of self-perception in the experience of stigma. We suspect weight stigma has the largest effect on individuals who recognize themselves as overweight, but that those individuals do not have to overweight by BMI standards. Only half our participants who perceived themselves as heavy met the objective BMI criterion for overweight. Conversely, five objectively overweight individuals and one objectively obese individual had average self-perceived weight. One important intervention implication is that targeting only those who are objectively overweight or obese may be inadequate.

Regarding the interaction among cortisol, condition, and self-perceived weight, we note the similarity between effect sizes for cortisol at T2 by condition between the average perceived weight and the heavy perceived weight groups. However, the self-perceived average weight group estimate was not statistically significant, increasing our confidence that the effects were likely driven by the heavy participants. Nonetheless, additional research should explore the effects of weight stigma among individuals perceiving their weight as average because perceived weight may be more malleable than BMI.

Our findings contribute to the scientific understanding of stigma by elucidating the physiological consequences of experiencing weight stigma. They also highlight the unique nature of weight as a stigmatized identity and may imply a "vicious cycle" model of weight stigma, wherein stigma results in cortisol secretion, promoting weight gain and begetting more stigma. Nationally representative longitudinal data show a relationship between weight discrimination and increased obesity risk (33) as does a longitudinal study showing that labeling young girls as "fat" is related to higher risk of adult obesity, independent of BMI in adolescence (34). Because cortisol is a known driver of eating (16,35) and fat deposition (24), this may explain how weight stigma exacerbates the risk for weight gain.

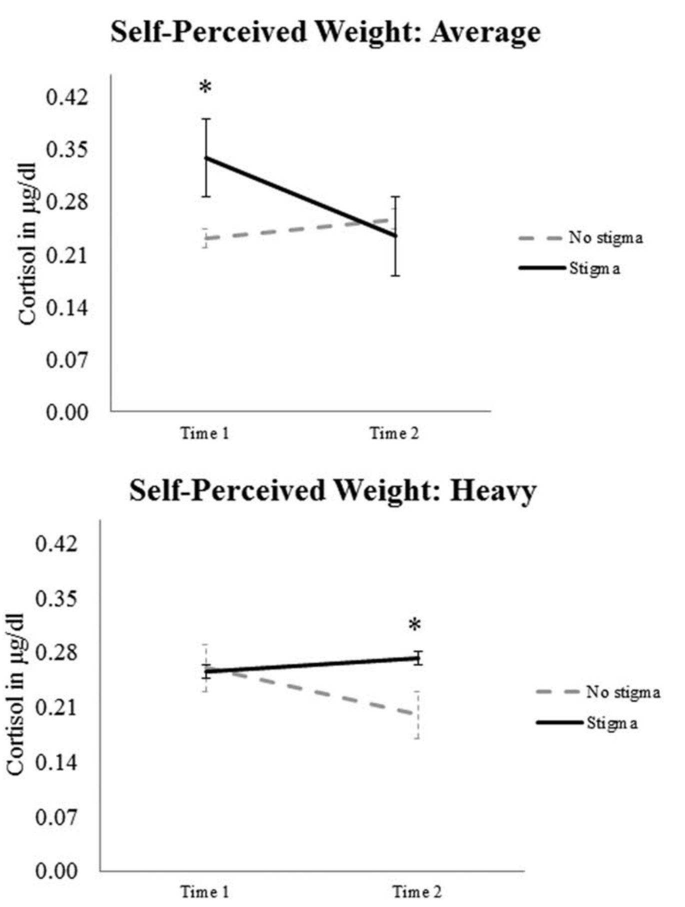

Figure 1 Cortisol at time 1 was significantly higher in the stigma condition compared with control ($^*P = 0.019$) among participants perceiving their size as average prior to the experimental manipulation. Thus, we conducted a 2 × 2 ANCOVA controlling for cortisol value at time 1. The analysis yielded a significant interaction between perceived weight and condition on cortisol at time 2 independent of cortisol at time 1. Individuals who perceived themselves as heavy secreted significantly more cortisol at time 2 in the stigma condition compared with the control condition ($^*P = 0.040$). No difference in cortisol at time 2 was observed for individuals who perceived themselves as average ($P = 0.130$). Bars represent standard error bars.

Our finding of sustained cortisol elevation is consistent with Schvey and colleagues (26) who found smaller decreases in cortisol after exposure to a weight stigmatizing video compared with a control video. The diurnal rhythm of cortisol is such that cortisol levels steadily decline throughout the day. Thus our finding of sustained elevation may functionally represents an increase in cortisol, compared with the normal pattern of steady decline. We attempted to mitigate the effects of diurnal rhythmicity by running sessions in the afternoon, but our window (1300h-1900h) was larger than what some recommend (1400h-1700h) (36). Regarding negative affect, although participants displayed slightly more negative affect in the stigma condition compared with the control condition, the difference was marginal. Likewise, negative affect was not significantly related to cortisol elevation. Such divergence between self-reported affect and cortisol levels are common. For example, Fischer and colleagues (37) examined cortisol and psychological stress responses over 7,145 hours and found that cortisol and psychological stress did not overlap 71.3% of the time (21). One implication of our findings is that weight stigma may have a physiological toll regardless of an individual's psychological experience. This points to the need to eradicate weight stigma rather than intervening at an individual level to help individuals cope with weight stigma.

We note additional limitations. First, we examined only females. We chose females because women experience more weight stigma than men (3), and women tend to perceive themselves to be overweight before reaching objective criteria of overweight (28). Future research should include men. Second, the number of overweight and obese participants in our sample was relatively low, as only 31.2% of our sample met the objective criterion for overweight ($n = 24$) or obesity ($n = 9$). As weight becomes more visible at higher BMIs, obese individuals may experience more stress than overweight individuals, provided they perceive themselves as overweight. We had too few obese participants to explore this idea, and future research should test this with a larger proportion of overweight and obese individuals. Additionally, slightly more than one-third of our sample identified as Asian. We had insufficient power to test for racial differences here, but research (38) suggests women who identify as Asian versus White share similar standards for beauty, as do those who identify as Latina versus white (39). Finally, though we reminded participants not to eat, drink, or exercise prior to the study, we did not measure eating or exercise, medications, medical conditions, waking time, or menstrual phase. We relied on randomization to distribute these variables equally, but it is possible that any one could have affected our results.

Despite these caveats, our study had several considerable strengths. We used a novel weight-relevant paradigm to directly expose participants to an active, interpersonal weight stigmatizing experience, expanding upon prior work using video or vignette paradigms (16,26). We chose shopping in order to mimic a real-world experience in which women likely experience weight stigma. Although advertising the study as a shopping activity could have influenced our sample selection, it likely represents a more conservative test of our hypotheses. Those who self-selected into a shopping study are less likely to have body issues that would encourage avoidance of shopping and are therefore likely *more* resilient to weight stigma processes. Thus, the fact that our results emerged despite the "shopping" paradigm bolsters our confidence in these findings. In order to isolate the independent effect of weight stigma, and not merely rejection or affect, the control group also experienced rejection, and we controlled for negative affect. Likewise, in order to tie our results directly to weight stigma and not, for example, weight salience, we weighed all participants.

These findings suggest one reason why overweight and obesity remain at high levels is because cortisol is obesogenic and weight stigma may undermine weight control. Overweight and obese individuals comprise the majority of the US population and weight stigma is on the rise (1), potentially affecting those who are not objectively overweight. Moreover, weight stigma might exacerbate long-term health outcomes related to obesity, especially in activating a cyclic pathogenesis via cortisol. Therefore, making efforts to reduce weight stigma is important and has the potential to affect millions. O

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References

1. Andreyeva T, Puhl RM, Brownell KD. Changes in perceived weight discrimination among Americans, 1995–1996 through 2004–2006. *Obesity* 2008;16:1129-1134.
2. Crandall CS, D'Anello S, Sakalli N, Lazarus E, Nejtardt GW, Feather NT. An attribution-value model of prejudice: anti-fat attitudes in six nations. *Personal Soc Psychol Bull* 2001;27:30-37.
3. Puhl RM, Heuer CA. The stigma of obesity: a review and update. *Obesity* 2009;17: 941-964.
4. Wang SS, Brownell KD, Wadden TA. The influence of the stigma of obesity on overweight individuals. *Int J Obes Relat Metab Disord J Int Assoc Study Obes* 2004;28:1333-1337.
5. Rudman LA, Feinberg J, Fairchild K. Minority members' implicit attitudes: automatic ingroup bias as a function of group status. *Soc Cogn* 2002;20:294-320.
6. Schwartz MB, Vartanian LR, Nosek BA, Brownell KD. The influence of one's own body weight on implicit and explicit anti-fat bias. *Obesity* 2006;14:440-447.
7. National Center for Health Statistics. *Health, United States, 2012: With Special Feature on Emergency Care*. Hyattsville, MD: NCHS; 2013.
8. Friedman KE, Reichmann SK, Costanzo PR, Zelli A, Ashmore JA, Musante GJ. Weight stigmatization and ideological beliefs: relation to psychological functioning in obese adults. *Obes Res* 2005;13:907-916.
9. Friedman KE, Ashmore JA, Applegate KL. Recent experiences of weight-based stigmatization in a weight loss surgery population: psychological and behavioral correlates. *Obesity* 2008;16:S69-S74.
10. Jackson TD, Grilo CM, Masheb RM. Teasing history, onset of obesity, current eating disorder psychopathology, body dissatisfaction, and psychological functioning in binge eating disorder. *Obes Res* 2000;8:451-458.
11. Puhl RM, Brownell K. Confronting and coping with weight stigma: an investigation of overweight and obese adults. *Obesity* 2006;14:1802-1815.
12. Rosenberger PH, Henderson KE, Bell RL, Grilo CM. Associations of weight-based teasing history and current eating disorder features and psychological functioning in bariatric surgery patients. *Obes Surg* 2007;17:470-477.
13. Vartanian LR, Shaprow JG. Effects of weight stigma on exercise motivation and behavior: a preliminary investigation among college-aged females. *J Health Psychol* 2008;13:131-138.
14. Vartanian LR, Novak SA. Internalized societal attitudes moderate the impact of weight stigma on avoidance of exercise. *Obesity (Silver Spring)* 2011;19:757-762.
15. Sutin AR, Stephan Y, Carretta H, Terracciano A. Perceived discrimination and physical, cognitive, and emotional health in older adulthood. *Am J Geriatr Psychiatry* 2014:1-9.
16. Major B, Hunger JM, Bunyan DP, Miller CT. The ironic effects of weight stigma. *J Exp Soc Psychol* 2014;51:74-80.
17. Schvey NA, Puhl RM, Brownell KD. The impact of weight stigma on caloric consumption. *Obesity* 2011;19:1957-1962.
18. Puhl RM, Latner JD. Stigma, obesity, and the health of the nation's children. *Psychol Bull* 2007;133:557-580.
19. Matthews KA, Salomon K, Kenyon K, Zhou F. Unfair treatment, discrimination, and ambulatory blood pressure in black and white adolescents. *Health Psychol* 2005;24:258-265.
20. Major B, Eliezer D, Rieck H. The psychological weight of weight stigma. *Soc Psychol Personal Sci* 2012;3:651-658.
21. Dickerson SS, Kemeny ME. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychol Bull* 2004;130:355-391.
22. Dickerson SS, Gruenewald TL, Kemeny ME. When the social self is threatened: shame, physiology, and health. *J Pers* 2004;72:1191-1216.
23. Torres S, Nowson C. Relationship between stress, eating behavior, and obesity. *Nutrition* 2007;23:887-894.
24. Peckett AJ, Wright DC, Riddell MC. The effects of glucocorticoids on adipose tissue lipid metabolism. *Metabolism* 2011;60:1500-1510.
25. Sothmann MS, Buckworth J, Claytor RP, Cox RH, White-Welkley JE, Dishman RK. Exercise training and the cross-stressor adaptation hypothesis. *Exerc Sport Sci Rev* 1996;24:267-287.
26. Schvey NA, Puhl RM, Brownell KD. The stress of stigma: exploring the effect of weight stigma on cortisol reactivity. *Psychosom Med* 2014;76:156-162.

27. Griffin DW, Ross L. Subjective construal, social inference, and human misunderstanding Zanna MP (ed.). *Adv Exp Soc Psychol* 1992;24:319-365.
28. Crawford D, Campbell K. Lay definitions of ideal weight and overweight. *Int J Obes Relat Metab Disord J Int Assoc Study Obes* 1999;23:738-745.
29. Phillips EL, Pratt HD. Eating disorders in college. *Pediatr Clin North Am* 2005;52: 85-96.
30. Nicolson NA. Measurement of cortisol. In: Luecken LJ, Gallo LC (eds.). *Handbook of Physiological Research Methods in Health Psychology*. Thousand Oaks: Sage; 2008, pp 37-74.
31. Goffman E. *Stigma: Notes on the Management of Spoiled Identity*. New York: Simon-Schuster; 1963.
32. Watson D, Clark LA, Tellegen A. Development and validation of brief measures of positive and negative affect: the panas scales. *J Pers Soc Psychol* 1988;54:1063-1070.
33. Sutin AR, Terracciano A. Perceived weight discrimination and obesity. *PLoS One* 2013;8:1-4.
34. Hunger JM, Tomiyama AJ. Weight labeling and obesity: a 10-year longitudinal study of girls aged 10–19. *JAMA Pediatr* 2014;168(6):579-580.
35. Epel E, Lapidus R, McEwen B, Brownell K. Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology* 2001;26:37-49.
36. Kirschbaum C, Hellhammer D. Salivary cortisol in psychobiological research: an overview. *Neuropsychobiology* 1989;22:150-169.
37. Fischer JE, Calame A, Dettling AC, Zeier H, Fanconi S. Experience and endocrine stress responses in neonatal and pediatric critical care nurses and physicians. *Crit Care Med* 2000;98:3281-3288.
38. Evans PC, McConnell A. Do racial minorities respond in the same way to mainstream beauty standards? Social comparison processes in Asian, Black, and White women. *Self Identity* 2003;2:153-167.
39. Pepper AC, Ruiz SY. Acculturation's influence on antifat attitudes, body image and eating behaviors. *Eat Disord* 2007;15:427-447.