Published Ahead of Print on January 16, 2014 as 10.1097/PSY.0000000000000031

The Stress of Stigma: Exploring the Effect of Weight Stigma on Cortisol Reactivity

NATASHA A. SCHVEY, MS, MPHIL, REBECCA M. PUHL, PHD, AND KELLY D. BROWNELL, PHD

Objective: To determine the physiological impact of exposure to weight stigma by examining alterations in salivary cortisol among lean and overweight women. **Methods:** Participants were 123 lean and overweight adult women (mean body mass index = 26.99 [7.91] kg/m^2). Participants' salivary cortisol was assessed both before and after either a weight stigmatizing or a neutral video. Participants completed self-report measures of mood and reactions to the video. Height and weight were obtained at the conclusion of the study. **Results:** Participants in the stigmatizing condition exhibited significantly greater cortisol reactivity when compared with those in the neutral condition, irrespective of weight status (Pillai trace = 0.077; $F(1,85) = 7.22$, $p = .009$). Lean and overweight women in the stigmatizing condition were equally likely to find the video upsetting and were equally likely to report that they would rather not see obese individuals depicted in a stigmatizing manner in the media. **Conclusions:** Exposure to weight-stigmatizing stimuli was associated with greater cortisol reactivity among lean and overweight women. These findings highlight the potentially harmful physiological consequences of exposure to weight stigma. **Key words:** weight stigma, salivary cortisol, stress.

BDI = Beck Depression Inventory II; **BMI** = body mass index; **PSS** = Perceived Stress Scale.

INTRODUCTION

Overweight and obese individuals are frequent targets of stigma and prejudice in multiple domains including employment, education, health care, the legal system, and the media (1,2). In the United States, the prevalence of reported weight discrimination increased by 66% between 1995 and 2005 (3) and is now comparable with rates of racial discrimination, especially among women (4). Overweight and obese individuals who are exposed to weight stigma are at greater risk for adverse psychological outcomes including depression, anxiety, suicidality, negative body image, and reduced self-esteem (5). In addition, exposure to weight stigma may promote unhealthy eating behaviors such as binge eating, increased caloric consumption, and reluctance to diet (5–7), while also attenuating physical activity and motivation to exercise (8,9), all of which impair weight loss efforts and promote obesity.

In addition to the associations between weight stigma and negative psychological outcomes, there is preliminary evidence for a relationship between weight stigma and other health outcomes. For instance, studies have demonstrated relationships between weight stigma and mean arterial pressure (10), nondiabetic glycemic control (11), self-rated health (12), and morbidity (13). However, no published studies, to our knowledge, have investigated the immediate physiological impact of exposure to weight stigma.

Given that exposure to other forms of discrimination has been linked to negative health consequences (14–16) and physiological reactivity (17,18), it is plausible that exposure to weight stigma induces similar physiological outcomes. Because overweight individuals are already vulnerable to multiple health consequences (19–21), any added risk imparted by the stress of exposure to weight stigma will be crucial to identify. Importantly, the experience of stress and subsequent cortisol reactivity are associated with adverse consequences including hypertension, dyslipidemia, immunosuppresion, osteoporosis, insulin resistance, and other metabolic and endocrine abnormalities (e.g., (22)). Furthermore, glucocorticoids stimulate the appetite, blunt satiety cues, contribute to visceral fat retention, and increase preferences for palatable foods, thereby promoting weight gain through a variety of mechanisms (23). However, research has indicated that increased abdominal adiposity in chronically stressed rats is actually associated with blunted hypothalamic-pituitary-adrenal axis reactivity in response to acute stressors, indicating that the exact nature of the relationship between physiological stress response and body weight warrants further consideration and exploration (24). Given the numerous health risks associated with excess adiposity (25), as well as the prevalence and social acceptability of weight stigma (2), determining the impact of exposure to weight stigma on physiological outcomes is a public health priority.

The present study assessed whether alterations in salivary cortisol occur in response to exposure to weight-stigmatizing stimuli. To our knowledge, this is the first study to assess objective physiological response to weight-stigmatizing stimuli in a randomized-controlled experiment. Because pejorative depictions of overweight individuals are ubiquitous in various forms of media (26–30) and antiobesity campaigns (31), it is important to identify what impact this stigmatizing content may have on the physiological arousal of viewers. We hypothesized that women exposed to weight-stigmatizing stimuli from the media would demonstrate greater cortisol reactivity compared with those in a neutral condition and that this effect would be particularly pronounced among overweight women. Both lean and overweight women were included in the present study because some research (32) has shown that weight stigma may negatively impact women of all weight strata.

METHODS AND PROCEDURES

The study was limited to women because consistent sex differences have been observed in cortisol reactivity in response to psychological stressors (33,34). In addition, some studies suggest that women are more vulnerable to weight stigma than men (2,4). Because serum cortisol levels vary with age (34) and younger adults experience weight stigma more frequently (35), participation was limited to individuals between 18 and 50 years of age.

From the Department of Psychology (N.A.S.) and Rudd Center for Food Policy and Obesity (R.M.P.), Yale University, New Haven, Connecticut; and Sanford School of Public Policy (K.D.B.), Duke University, Durham, North Carolina.

Address correspondence and reprint requests to Natasha A. Schvey, MS, MPhil, Department of Psychology, Yale University, 2 Hillhouse Ave, New Haven, CT 06520. E-mail: natasha.schvey@yale.edu

Received for publication July 23, 2013; revision received November 9, 2013.
DOI: 10.1097/PSY.0000000000000031

0033-3174/14/7602–0000

Women were recruited from a university in the northeastern United States and the surrounding community (city population: 130,000) from December 2010 to December 2011. The study was advertised as research exploring "the effects of video clips on physical reactions, mood, and behavior." Individuals were excluded if they were pregnant or nursing, if they had been diagnosed as having Cushing syndrome, or if they were currently or had recently taken prednisone. Individuals who qualified for the study were asked to refrain from consuming any food or beverage and to abstain from the use of nicotine for at least 1 hour before study participation. All participants were also asked to avoid alcohol, caffeine, and vigorous exercise for at least 1 day before study initiation to minimize variations in baseline cortisol secretion (33). Before study initiation, participants were asked to report their height and weight over e-mail or telephone to determine weight status for the purposes of randomization. A total of 284 individuals contacted the investigators regarding study participation; 152 individuals failed to complete the study because of exclusion criteria, lack of responsiveness, or cancelled/missed appointments. One hundred thirty-two women participated in the study; eight participants were later excluded because of invalid cortisol measurement and one woman was excluded for missing body mass index (BMI) information due to instrumentation error. The final sample consisted of 123 women (Fig. 1).

Participants' height and weight were measured at the conclusion of the study using a stadiometer and digital scale from which BMI was calculated (in kilograms per meter squared). Individuals were classified as either lean (BMI = 18.5–24.9) or overweight (BMI $\geq$ 25) according to World Health Organization guidelines.

Procedures

To avoid interference from circadian cycling of cortisol levels, participants were admitted individually at the laboratory between 2:00 and 4:00 PM. After informed consent, participants were randomized to either the stigmatizing or the neutral video condition; randomization was stratified by self-reported weight status to balance the proportion of overweight and lean women who watched each of the two videos. Participants were not weighed at the study onset because this may distress female participants or prime them to the purpose of the study; thus, randomization was stratified based on the self-reported height and weight that was provided to research team during initial telephone/e-mail screening.

The stigmatizing video consisted of a 10-minute compilation of 24 brief clips from recent popular television shows and movies in which overweight and obese women were depicted in a pejorative manner, or portrayed in stereotypical ways (e.g., overeating, wearing ill-fitting clothing, struggling to exercise, dancing in a comical manner, etc). These clips were primarily taken from comedic films, situation comedies, or reality television shows, (e.g., The Biggest Loser, Drop Dead Diva, Say Yes to the Dress, Friends, etc) and are strongly representative of how obese individuals are depicted in film, television (26–29), and news media (30). For instance, one representative scene depicted an actress in a fat-suit dancing seductively for a group of construction workers who appear to be repulsed. Another scene depicts an overweight woman trying on multiple pairs of ill-fitting pants in a comical manner. The neutral video (also 10 minutes long) depicted 20 emotionally neutral scenes such as clips about the invention of the radio, commercials for household products, car insurance, and so on. Clips were excluded from the final video if they were perceived as emotionally valenced by the research team.

Before watching the video, participants underwent a 20-minute relaxation period to ensure accurate baseline measurement of cortisol (36). Participants then chewed on a synthetic cotton swab for 60 seconds using Sarstedt Salivettes that were later assayed at a university-affiliated laboratory. Because cortisol levels peak approximately 30 minutes after a psychologically stressful experience (33), postvideo salivary cortisol was assessed 30 minutes after completion of the video. In addition, participants completed questionnaires regarding perceptions of the video, mood, antifat attitudes, and basic demographic information. After completion of all measures, participants were debriefed regarding the purpose of the study. This study received approval from the Yale University Human Subjects Committee.

Measures

Salivary Cortisol

Salivary cortisol was collected using Salivette for Cortisol Testing (Sarstedt, Numbrecht, Germany) tubes, specifically designed to measure free cortisol (in micrograms per deciliter). Participants were asked to chew gently on a synthetic cotton saliva collector for 60 seconds and then to place the cotton swab back in the designated tube. Samples were stored in a research freezer until transported on ice packs to be assayed. Saliva samples were assayed at the medical school

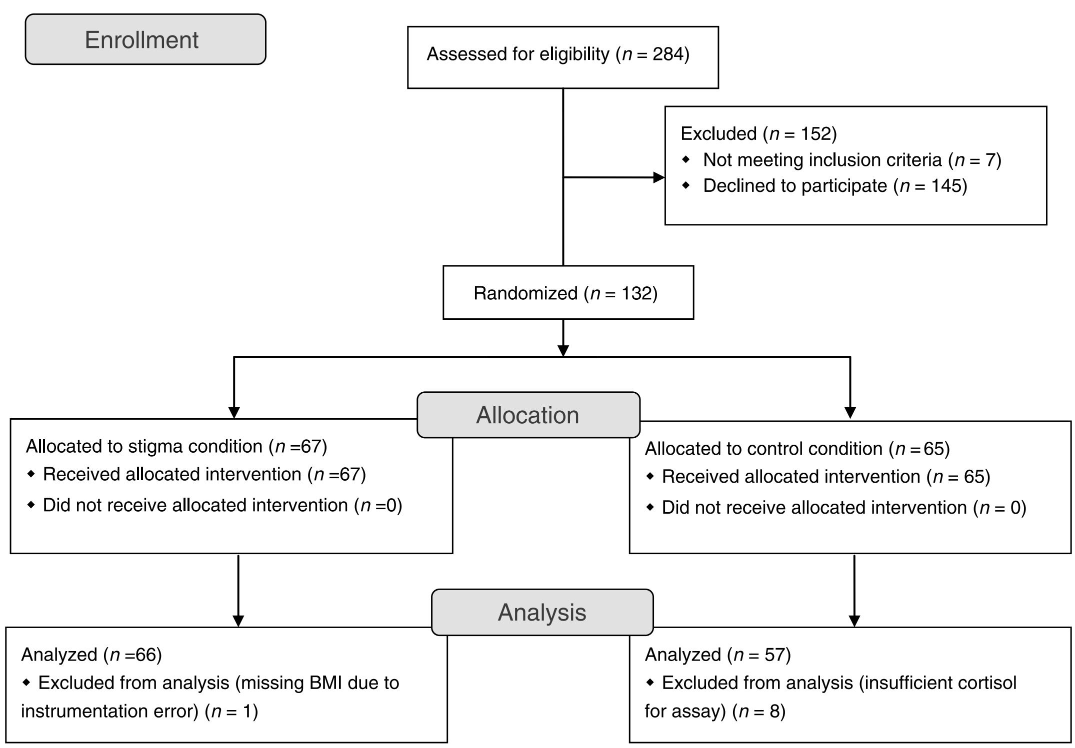

Figure 1. Randomization flowchart.

affiliated with the university at which the study was conducted. The specimens were thawed to room temperature and centrifuged, and the supernatant was assayed using Coat a Count Cortisol Determination Kit (Siemens Healthcare Diagnostics Products, Los Angeles, CA). Two 200-μl aliquots of supernatant for each sample (i.e., duplicates) were pipetted into the coated tubes provided with the kit. One milliliter of I125 cortisol was added to each sample, vortexed, and then incubated at room temperature for 3 hours. After this procedure, the tubes were decanted thoroughly and the content was aspirated then placed in a gamma counter for 60 seconds. Results were calculated using a logit-log representation of the calibration curve.

Participants provided demographic information and completed a battery of self-report measures both before after the video, administered in the order presented below:

Demographic Information

Upon study entry, participants were asked to report their age, race and ethnicity, educational background, and occupation (if applicable). Participants also completed questions pertaining to their sleep-wake and menstrual cycles because these variables may influence cortisol level.

The *Positive Affect Negative Affect Schedule* (37) is a 20-item scale that measures participants' positive and negative affect along a number of dimensions. Participants are asked to indicate to what extent they feel a certain way (e.g., alert, enthusiastic, distressed, scared) on a 5-point Likert scale. The Positive Affect Negative Affect Schedule was administered both before and after the video clips, and thus, the "state" instructions were used. Cronbach α for the pretest measure was as follows: α values = .917 and .819, for the positive and negative subscales, respectively. Cronbach α for the posttest measure was as follows: α values = .93 and .91, for the positive and negative subscales, respectively.

The Beck Depression Inventory II (*BDI-II*) (38) consists of 21 items that assess depressive symptoms (e.g., I feel utterly worthless) on a scale from 0 to 3. Higher scores reflect more severe levels of depression, with a BDI score of 21 or higher indicating moderate to extreme depression. The BDI has demonstrated high internal consistency in both psychiatric and community samples (mean coefficient = 0.87) (38,39). The BDI has also shown strong test-retest reliability and high construct validity (38). The reliability of this measure in the present sample was α = .89.

The Fat Phobia Scale (shortened form) was adapted from the original Fat Phobia Scale (40). The shortened version of the Fat Phobia Scale lists 14 pairs of adjectives that may be used to describe overweight or obese individuals (e.g., attractive/unattractive, lazy/industrious, no willpower/has willpower). Participants are asked to indicate, on a 5-point Likert scale, which adjective in the pair best represents overweight individuals. The Fat Phobia Scale has exhibited strong reliability and concurrent validity with the original version (40). Total scores range from 1 to 5; a score of 5 represents the greatest amount of fat phobia. The reliability of this measure in the present sample was α = .93.

The *Perceived Stress Scale* (PSS) consists of 10 items which participants answer on a Likert scale of 0 to 4 (0 meaning never and 4 meaning very often). The PSS evaluates the extent to which situations in the participant's life are judged to be stressful. The PSS has been shown to be reliable, valid, and internally consistent in multiple samples (41,42). The reliability of this measure in the present sample was α = .85.

The *Post-Video Questionnaire* is a two-part, 19-item scale developed for this study that assessed participants' emotional reactions to the video clips (e.g., happy, sad, anxious, etc). Participants also indicated how they felt about their own body shape and weight, and how much they related to the individuals depicted in the video. Finally, participants were asked about their perceptions of the video (e.g., was it stigmatizing, was it an accurate representation of how obese people are portrayed on TV, etc). This measure used a 5-point Likert scale ranging from 1 to 5 (1 = "strongly disagree" and 5 = "strongly agree").

Height and Weight Information

Participants' height and weight were measured using a stadiometer and digital scale.

Statistical Analysis

All analyses were conducted using SPSS for Windows version 19 (SPSS, Inc, Chicago, IL). p Values were considered significant if they were less than .05, and all tests were two tailed. Statistical analyses were conducted from May 2012 to February 2013.

All dependent variables were examined for outliers, normality, and missing data. Eight participants (neutral condition) were excluded because of saliva samples that were insufficient for assay, and one participant (stigmatizing condition) was excluded for missing BMI value (due to instrumentation error). Analyses indicated that measures of prevideo and postvideo cortisol (in micrograms per deciliter) were not normally distributed (Shapiro-Wilk values = <.001). Subsequently, the prevideo and postvideo cortisol variables were log transformed to satisfy assumptions of normality. All subsequent analyses of salivary cortisol use the transformed data. To assess for outliers, relevant variables were converted to standardized scores. Standardized scores of ±2.5 or higher were considered outliers (43). Conversion to standardized scores revealed one univariate outlier in the prevideo cortisol variable (neutral condition) and three univariate outliers in the postvideo cortisol variable (two in the neutral condition and one in the stigmatizing condition). All four outliers' scores were much higher than their respective groups' mean. These outliers were transformed according to previous conventions (43); raw scores were transformed to the next highest score from the respective group plus 1 unit to bring them closer to the distribution. Results did not differ when the outlier's untransformed data were included; however, to be conservative, all subsequent analyses of salivary cortisol use these four outliers' transformed data.

To ensure the success of randomization, a one-way analysis of variance (ANOVA) was used to compare those in the neutral condition with those in the stigmatizing condition along relevant baseline variables. Partial correlations, controlling for BMI, were conducted on psychological variables and baseline cortisol level. A repeated-measures analysis of covariance (ANCOVA) was performed to detect the impact of video type on salivary cortisol reactivity while controlling for relevant variables.

RESULTS

Participant Characteristics

The final sample consisted of 123 lean (n = 69; mean [standard deviation {SD}] BMI = 21.90 [2.17]; range, 16.60–24.80) and overweight (n = 54; mean [SD] BMI = 33.74 [7.71]; range, 25.10–60.20) adult women. The mean (SD) age was 26.98 (9.21) years, and the mean (SD) BMI was 27.05 (8.00) kg/m^2 (range, 16.60–60.20). The racial/ethnic distribution was as follows: 51.2% white, 19.4% black, 12.4% Asian, 7.8% Hispanic, 3.9% Native American, and 5.4% "other" (see Table 1). Most participants (72.6%) had no affiliation with the university at which the study was conducted. Of the 27.4% of participants affiliated with the university, 12.0% were staff, 9.4% were graduate students, and 6.0% were undergraduates.

Seven individuals' BMI classified them as underweight (<18.5), but results did not differ when these individuals were excluded; thus, they were retained in the final analyses. Because women at a lower range of overweight may experience as much weight-related stigma as their obese peers (35), the decision was made a priori to combine obese (BMI ≥ 30.0 kg/m^2; n = 33 [25%]) and overweight (30.0 kg/m^2 > BMI > 24.9 kg/m^2; n = 22 [17%]) individuals to form one "overweight" group. The proportion of obese participants in the present study is representative of the regional average (Northeast: 25.3%), although lower than the national average (35.7%) (44). Eight participants in the neutral condition were excluded because of insufficient cortisol either prevideo (n = 1) or postvideo (n = 7). These women did not differ from the remainder of the sample along any relevant variables including age, BMI, fat phobia, perceived stress, or depression.

TABLE 1. Descriptive Statistics by Condition

Measure	Neutral Condition			Stigma Condition			
	M	SD	*n*	M	SD	*n*	*F*
Body mass index, kg/m^2	27.38	7.26	55	26.76	8.62	66	0.175
Age, y	26.84	10.27	57	27.11	8.27	66	0.025
Fat phobia	2.75	0.91	50	2.53	0.69	64	2.08
Depression	5.77	6.81	56	8.37	7.16	66	4.16*
Perceived stress	18.54	7.05	57	21.76	7.38	66	6.05*
Positive affect (Pre)	27.98	10.07	55	27.08	8.41	66	0.291
Negative affect (Pre)	11.87	3.46	55	13.41	4.13	66	4.79*
Raw cortisol (Pre), μg/dl	0.228	0.134	57	0.207	0.109	66	0.982
Raw cortisol (Post), μg/dl	0.172	0.107	57	0.186	0.094	66	0.597
Race							0.460
White	—	—	26	—	—	37	—
Black	—	—	13	—	—	12	—
Hispanic	—	—	7	—	—	3	—
Asian	—	—	5	—	—	8	—
Other	—	—	6	—	—	6	—

M = mean; SD = standard deviation.
Statistical test conducted: one-way analysis of variance.
* $p < .05$.

A one-way ANOVA revealed no group differences between the stigmatizing condition (n = 66) and the neutral condition (n = 57) in age, race, BMI, antifat attitudes, or baseline positive affect. Those in the stigmatizing condition had higher baseline depression, perceived stress, and pretest negative affect when compared with those in the neutral condition (p values = .043, .015, and .031, respectively). Baseline cortisol levels did not differ between the groups (see Tables 1 and 2). Partial correlations, controlling for BMI, were conducted on relevant variables among the full sample. Stress was the only psychological variable that was significantly associated with baseline cortisol level (see Table 3 for full bivariate correlation matrix).

Effect of Video Type on Cortisol Reactivity

Owing to the diurnal pattern of salivary cortisol and the nature of the stressor used in the present paradigm, some decreases in salivary cortisol were anticipated for all participants regardless of condition (18,45); thus, results focus on the degree of change (rather than increase) in cortisol level from prevideo to postvideo, commonly referred to as *cortisol reactivity* (18,45,46).

To assess the interaction between time point and video type on cortisol reactivity, a repeated-measures ANCOVA was performed. Age, race, BMI, time since waking, depression, stress, and number of days since last menstrual cycle were included

TABLE 2. Descriptive Statistics by Participant Subgroup

Measure	Overweight/Stigma			Lean/Stigma			Overweight/Neutral			Lean/Neutral			
	M	SD	*n*	M	SD	*n*	M	SD	*n*	M	SD	*n*	*F*
Body mass index, kg/m^2	34.89^a	9.09	25	21.81^b	2.19	43	32.78^a	6.39	30	22.05^b	2.16	30	52.56**
Age, y	26.88	8.36	25	27.35	8.34	43	28.50	11.99	30	24.70	7.42	30	0.92
Fat phobia	2.76	0.69	24	2.46	0.72	42	2.71	0.86	25	2.83	0.88	28	1.49
Depression	10.04	7.84	25	7.63	6.89	43	7.07	7.99	29	5.60	5.88	30	1.81
Perceived stress	23.96^a	7.81	25	20.74	7.00	43	18.60^b	8.06	30	18.60	5.62	30	3.37*
Positive affect (Pre)	30.16	9.02	25	25.23^a	8.15	43	31.35^b	10.20	28	25.57	8.97	40	3.96*
Negative affect (Pre)	14.00	4.21	25	13.11	4.01	43	11.93	2.89	28	12.17	4.13	30	1.64
Raw cortisol (Pre), μg/dl	0.19	0.11	25	0.22	0.11	43	0.19	0.13	30	0.27	0.14	29	2.39
Raw cortisol (Post), μg/dl	0.19	0.11	25	0.18	0.09	41	0.13^a	0.09	27	0.22^b	0.13	29	3.59*

M = mean; SD = standard deviation.
Statistical test conducted: one-way analysis of variance with Bonferroni post hoc comparisons.
* $p < .05$.
** $p < .01$.

TABLE 3. Partial Correlations Controlling for BMI (For Full Sample)

	Age	Fat Phobia	Depression	Stress	Positive Affect	Negative Affect	Cortisol
Age	1						
Fat phobia	0.199	1					
Depression	−0.123	−0.357[a]	1				
Perceived stress	−0.161	−0.266[b]	0.712[a]	1			
Positive affect (Pre)	−0.010	0.132	−0.144	−0.249	1		
Negative affect (Pre)	−0.094	−0.119	0.310[b]	0.460[a]	0.012	1	
Baseline cortisol	−0.010	−0.034	0.170	0.323[b]	−0.170	0.135	1

BMI = body mass index.
Statistical test conducted: partial correlations.
[a] Correlation is significant at the .001 level (two tailed).
[b] Correlation is significant at the .05 level (two tailed).

as covariates in the model because these variables may affect cortisol level (18,47,48). Results revealed a significant time by condition interaction on cortisol reactivity, such that when in the stigmatizing condition, regardless of body weight, women experienced a significantly smaller decline in cortisol level from prevideo to postvideo as compared with those in the neutral condition (Pillai trace = 0.073; $F(1,86) = 6.66$, $p = .012$). Thus, those in the stigmatizing condition experienced sustained cortisol elevation, whereas those in the neutral condition experienced a greater decline from prevideo to postvideo (Fig. 2). Age was the only other significant variable in the model (Pillai trace = 0.045; $F(1,86) = 4.05$, $p = .047$). To further ascertain whether weight status affected cortisol reactivity, an additional repeated-measures ANCOVA was performed to compare overweight with obese participants. There were no differences in cortisol reactivity between overweight and obese respondents in either the stigmatizing or the neutral condition (p values = .095 and .735, respectively).

Perceptions of Video

To determine the effect of video type on mood, participants in the stigmatizing condition were compared with those in the neutral condition. Results indicated that individuals who viewed the stigmatizing video were more likely to feel upset ($F(1,128) = 83.491$, $p < .001$, $\eta^2 = 0.39$), anxious ($F(1,128) = 26.836$, $p < .001$, $\eta^2 = 0.17$), sad ($F(1,128) = 61.585$, $p < .001$, $\eta^2 = 0.33$), and angry ($F(1,128) = 39.37$, $p < .001$, $\eta^2 = 0.24$) after the video as compared with those who viewed the neutral video. Bonferroni Hochberg post hoc tests revealed that overweight individuals who viewed the stigmatizing video were more likely to "relate to the individuals" in the video as compared with lean individuals in the stigmatizing condition ($p = .008$). Both overweight and lean individuals who viewed the stigmatizing video were equally likely to dislike the way that obese characters were portrayed and would prefer not to view media that depicts obese characters in this way. There were no differences between obese and overweight participants on any variables of interest.

Impact of Video Condition and Weight Status on Mood

A one-way ANOVA was performed to assess changes in negative and positive affect from prevideo to postvideo among the two conditions. Results revealed that participants in the stigmatizing condition reported a significantly greater increase in state negative affect after the video when compared with those in the neutral condition ($F(1,127) = 5.291$, $p = .023$, $\eta^2 = 0.04$).

DISCUSSION

The present study is the first, to our knowledge, to examine the impact of exposure to weight stigma on neuroendocrine stress in a laboratory setting and to assess these outcomes among both lean and overweight women. Findings revealed that exposure to weight-stigmatizing stimuli was associated with greater cortisol reactivity among women of all weight strata. Importantly, BMI was not a significant covariate in the model and did not moderate the findings, indicating that exposure to weight-stigmatizing stimuli was physiologically arousing for all women, irrespective of body weight. This finding differed from the initial hypothesis that overweight women would demonstrate greater cortisol reactivity than lean women and that cortisol reactivity would be associated with body weight. There was also no difference observed between obese and overweight

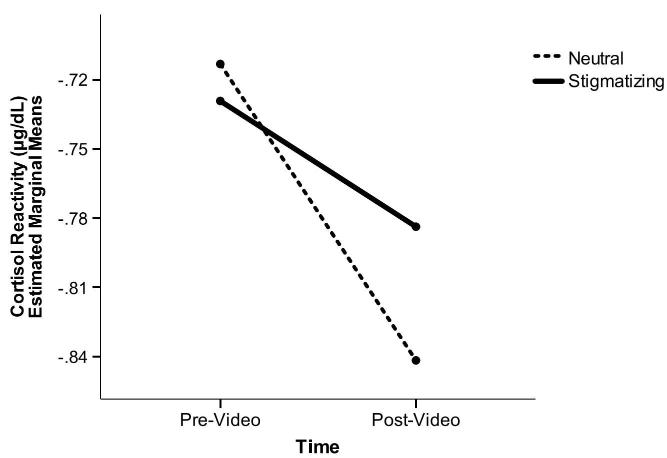

Figure 2. Effect of video type on cortisol reactivity. Statistical test conducted: repeated-measures analysis of covariance. Pillai trace = 0.073; $F(1,86) = 6.66$, $p = .012$. Standard errors = 0.040 (neutral) and 0.033 (stigmatizing). Covariates appearing in the model are evaluated at the following values: age = 26.65 years, BMI = 26.43 kg/m^2, time since waking = 382.43 minutes, perceived stress = 20.18, BDI-II Total Score = 7.12, days since last. menstrual cycle = 16.16. BMI = body mass index; BDI-II = BDI = Beck Depression Inventory II.

individuals in either of the two conditions, although this may be the result of the small sample size of each group (n values = 33 and 22, respectively). Additional research is needed to determine the mechanism for the finding that all women, irrespective of body weight, were physiologically reactive to the stigmatizing content. For instance, it may be that women, regardless of body weight, are sensitive to weight stigma or have been stigmatized due to weight (32). In addition, lean women may overestimate their body weight (49), thereby increasing empathy and identification with the overweight women depicted in the video. Furthermore, all of the stigmatizing clips depicted women; thus, by virtue of a shared sex, participants may have identified with the participant in the film. This mechanism may be partially supported by prior research indicating that stigma that is salient to an individual, even when not directed specifically at that individual, may elicit physiological arousal (50).

Subjective measures of mood and reactions to the videos indicated that those in the stigmatizing condition were significantly more upset, anxious, angry, and sad after the video compared with those in the neutral condition. There was no difference in the degree to which overweight and lean women reported feeling upset, sad, or anxious after the stigmatizing video. Overweight and lean women in the stigmatizing video condition were equally likely to report that they would rather not see stigmatizing depictions of obese individuals in the media.

Results of this study indicate that not only do women of all weight strata object to stigmatizing depictions of overweight and obese individuals, but also these negative depictions result in increased neuroendocrine stress as measured by salivary cortisol. These findings add to the scant literature demonstrating that exposure to weight stigma may affect health indices (11,13,51). The present findings provide novel evidence that exposure to weight-stigmatizing stimuli, even when not directed specifically at an individual, may contribute to physiological reactivity (16).

The present study is limited on its reliance on two time points of salivary cortisol. Future research should assess physiological response immediately after exposure to stigmatizing material and at several time points after exposure to assess the differential rate of recovery and the potentially lingering effects of exposure to stigma. An allostatic panel may also be advantageous for future research to ascertain, with more specificity, the effect of weight stigma on physiological response. In addition, α-amylase may be a useful index of stress response because levels have been demonstrated to peak immediately after exposure to a stressor (52), whereas cortisol levels peak approximately 30 minutes poststressor (33).

In addition, the stigmatizing group endorsed greater baseline depression, perceived stress, and negative affect when compared with those in the neutral condition. However, baseline cortisol level did not differ between the two groups, and results focused on the degree of change; thus, it is unlikely that these baseline differences in affect influenced results significantly. In addition, the present study did not assess in vivo or self-reported experiences of weight stigma. Future research should explore the effect of experiential weight stigma on physiological reactivity, for example, subjecting participants to actual weight stigma through the use of confederates. Because the data are mixed regarding the relationship between BMI and the experience of weight stigma (32,35), additional research should explore whether obese women differ from overweight women in physiological response to stigma. Finally, future research should examine both men and women, as well as youth, who are vulnerable to weight stigmatization (53,54).

More extensive research is warranted to determine the chronic and additive effects of weight bias on physical health. This will be especially important given that overweight individuals experience frequent instances of weight stigma across multiple settings (35). Furthermore, it will be important to identify whether the cumulative experience of discrimination targeted at multiple stigmatized attributes bears more impact on physical health than weight discrimination alone, or if certain racial or ethnic identities may be protective for overweight individuals. As some research has demonstrated that positive depictions of obese persons may reduce antifat attitudes (55), it will also be useful to determine the impact of nonstigmatizing portrayals of obese individuals on physiological reactivity.

With considerable evidence documenting the negative effects of weight stigma (2,7,35), this study demonstrates another harmful consequence that has been previously unstudied, showing that exposure to weight-stigmatizing stimuli contributes to both psychological and physiological stress among women of all weight strata. Importantly, many clips included in the stigmatizing film were originally intended to be humorous; however, although laughter attenuates cortisol level (56), the content shown to participants actually yielded sustained cortisol elevation. Thus, stigmatizing stimuli that is not intended to be upsetting may still promote physiological reactivity and negative affect among viewers of all weight strata. These findings are notable in light of the numerous medical sequelae associated with obesity as well as the pervasiveness and social acceptability of weight stigma in the media (26–30). Given the high levels of media consumption among Americans (57), it is likely that millions of individuals are frequently exposed to weight-stigmatizing content that may promote neuroendocrine stress and subjective distress, signaling a public health concern. Finally, this study directly challenges recently proposed strategies to combat obesity with the use of stigma and negative social pressure (58). In fact, the present findings suggest that weight stigma may induce physiological stress and contribute to adverse health, thereby underscoring the importance of removing stigmatizing content from public health efforts to address obesity.

The authors would like to thank Katherine Levandoski and Jenny DePierre for their invaluable contributions to the present study.

Source of Funding and Conflicts of Interest: Research and project support was provided by the Rudd Center for Food Policy & Obesity. The authors have no conflicts of interest to declare.

REFERENCES

1. Schvey N, Puhl R, Levandoski K, Brownell K. The influence of a defendant's body weight on perceptions of guilt. Int J Obes 2013;37:1275–81.
2. Puhl R, Heuer C. The stigma of obesity: a review and update. Obesity 2009;17:941–64.
3. Andreyeva T, Puhl R, Brownell K. Changes in perceived weight discrimination among Americans: 1995–1996 through 2004–2006. Obesity 2008;16:1129–34.
4. Puhl R, Andreyeva T, Brownell K. Perceptions of weight discrimination: prevalence and comparison to race and gender discrimination in America. Int J Obes 2008;32:992–1000.
5. Friedman K, Ashmore J, Applegate K. Recent experiences of weight-based stigmatization in a weight loss surgery population: psychological and behavioral correlates. Obesity 2008;16:S69–74.
6. Puhl R, Latner J. Stigma, obesity, and the health of the nation's children. Psychol Bull 2007;133:557–80.
7. Schvey N, Puhl R, Brownell K. The impact of weight stigma on caloric consumption. Obesity 2011;10:1957–62.
8. Vartanian L, Novak S. Internalized societal attitudes moderate the impact of weight stigma on avoidance of exercise. Obesity 2010;19:757–62.
9. Seacat JD, Mickelson KD. Stereotype threat and the exercise/dietary health intentions of overweight women. J Health Psychol 2009;14:556–67.
10. Major B, Eliezer D, Rieck H. The psychological weight of weight stigma. Soc Psychol Pers Sci 2012;3:651–8.
11. Tsenkova V, Carr D, Schoeller D, Ryff C. Perceived weight discrimination amplifies the link between central adiposity and nondiabetic glycemic control (HbA1). Ann Behav Med 2011;41:243–51.
12. Muennig P, Bench KK. Obesity-associated stigma and physiological markers of stress: evidence from the Dominican Republic. Stress Health 2009;25:241–6.
13. Muennig P. The body politic: the relationship between stigma and obesity-associated disease. BMC Public Health 2008;8:128.
14. Wyatt SB, Williams DR, Calvin R, Henderson FC, Walker ER, Winters K. Racism and cardiovascular disease in African Americans. Am J Med Sci 2003;325:315–31.
15. Matheson K, Gill R, Kelly O, Anisman H. Cortisol and cardiac reactivity in the context of sex discrimination: the moderating effects of mood and perceived control. Open Psychol J 2008;1:1–10.
16. Hatzenbuehler ML, Phelan JC, Link BG. Stigma as a fundamental cause of population health inequalities. Am J Public Health 2013:e1–9.
17. Huebner DM, Davis MC. Gay and bisexual men who disclose their sexual orientations in the workplace have higher workday levels of salivary cortisol and negative affect. Ann Behav Med 2005;30:260–7.
18. Townsend S, Major B, Gangi C, Mendes W. From "in the air" to "under the skin": cortisol responses to social identity threat. Pers Soc Psychol Bull 2011;37:151–64.
19. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. Health Aff 2009;28:w822–31.
20. Schelbert KB. Comorbidities of oesity. Primary Care 2009;36:271–85.
21. Guh D, Zhang W, Bansback N, Amarsi Z, Birmingham CL, Anis A. The incidence of co-morbidities related to obesity and overweight: asystematic review and meta-analysis. Biomed Central 2009.
22. Rosmond R. Role of stress in the pathogenesis of the metabolic syndrome. Psychoneuroendocrinology 2005;30:1–10.
23. Gee G, Ro A, Gavin A, Takeuchi D. Disentangling the effects of racial and weight discrimination on body mass index and obesity among Asian Americans. Am J Public Health 2008;98:493–500.
24. Tomiyama AJ, Dallman MF, Epel ES. Comfort food is comforting to those most stressed: evidence of the chronic stress response network in high stress women. Psychoneuroendocrinology 2011;36:1513–9.
25. Kopelman P. Obesity as a medical problem. Nature 2000;404:635–43.
26. Himes S, Thompson J. Fat stigmatization in television shows and movies: a content analysis. Obesity 2007;15:712–8.
27. Greenberg B, Eastin M, Hofshire L, Lachlan K, Brownell K. The portrayal of overweight and obese persons in commercial television. Am J Public Health 2003;93:1342–8.
28. Fouts G, Burggraf K. Television situation comedies: female weight, male negative comments, and audience reactions. Sex Roles 2000;42:925–32.
29. White S, Brown N, Ginsburg S. Diversity of body types in network television programming: a content analysis. Commun Res Rep 1999;16:386–92.
30. Puhl RM, Peterson JL, Depierre JA, Luedicke J. Headless, hungry, and unhealthy: a video content analysis of obese persons portrayed in online news. J Health Commun 2013;19:19.
31. Puhl R, Peterson JL, Luedicke J. Fighting obesity or obese persons? Public perceptions of obesity-related health messages. Int J Obes 2012.
32. Vartanian L, Shaprow J. Effects of weight stigma on exercise motivation and behavior: a preliminary investigation among college-aged females. J Health Psychol 2008;13:131–8.
33. Kirschbaum C, Wust S, Hellhammer D. Consistent sex differences in cortisol responses to psychological stress. Psychosom Med 1992;54:648–57.
34. Larsson C, Gullberg B, Rastam L, Lindblad U. Salivary cortisol differs with age and sex and shows inverse associations with WHR in Swedish women: a cross-sectional study. BMC Endocr Disord 2009;9:16.
35. Puhl R, Brownell K. Confronting and coping with weight stigma: an investigation of overweight and obese adults. Obesity 2006;14:1802–15.
36. Blackhart G, Eckel L, Tice D. Salivary cortisol in response to acute social rejection and acceptance by peers. Biol Psychol 2007;75:267–76.
37. Watson D, Clark L, Tellegen A. Development and validation of brief measures of positive and negative affect: the PANAS scales. Pers Proc Ind Diff 1988;54:1063–70.
38. Beck A, Steer R, Carbin M. Psychometric properties of the Beck Depression Inventory: twenty-five years of evaluation. Clin Psychol Rev 1988;8:77–100.
39. Reynolds W, Gould J. A psychometric investigation of the standard and short form Beck Depression Inventory. J Consult Clin Psych 1981;49:306–7.
40. Bacon J, Scheltema K, Robinson B. Fat Phobia Scale revisited: the short form. Int J Obes 2001;2:252–7.
41. Sheldon C, Kamarck T, Mermelstein R. A global measure of perceived stress. J Health Soc Behav 1983;24:385–96.
42. Hewitt P, Flett G, Mosher S. The Perceived Stress Scale: factor structure and relation to depression symptoms in a psychiatric sample. J Psychopathol Behav Assess 1992;14:247–57.
43. Tabachnick B, Fidell L. Using Multivariate Statistics. 5th ed. New York, NY: Pearson Education; 2007.
44. Flegal K, Carroll M, Kit B, Ogden C. Prevalence of obesity and trends in the distribution of body mass index among us adults, 1999–2010. JAMA 2012;307:491–7.
45. Page-Gould E, Mendoza-Denton R, Tropp L. With a little help from my cross-group friend: Reducing anxiety in intergroup contexts through cross-group friendship. J Pers Soc Psychol 2008;95:1080–94.
46. Dickerson S, Kemeny M. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. Psychol Bull 2004;130:355–91.
47. Li L, Power C, Kelly S, Kirschbaum C, Hertzman C. Life-time socio-economic position and cortisol patterns in mid-life. Psychoneuroendocrinology 2007;32:824–33.
48. Cohen S. Socioeconomic Status, Race, and Diurnal Cortisol Decline in the Coronary Artery Risk Development in Young Adults (CARDIA) study. Psychosom Med 2006;68:41–50.
49. Fallon AE, Rozin P. Sex differences in perceptions of desirable body shape. J Abnorm Psychol 1985;94:102–5.
50. Richman LS, Jonassaint C. The effects of race-related stress on cortisol reactivity in the laboratory: implications of the Duke Lacrosse Scandal. Ann Behav Med 2008;35:105–10.
51. Muennig P, Lubetkin E, Jia H, Franks P. Gender and the burden of disease attributable to obesity. Am J Public Health 2006;96:1662–8.
52. Nater UM, Rohleder N, Gaab J, Berger S, Jud A, Kirschbaum C, Ehlert U. Human salivary alpha-amylase reactivity in a psychosocial stress paradigm. Int J Psychophysiol 2005;55:333–42.
53. Puhl R, Luedicke J, Heuer C. Weight-based victimization toward overweight and obese adolescents: observations and reactions of peers. J Sch Health 2011;81:696–703.
54. Puhl RM, Peterson JL, Luedicke J. Weight-based victimization: bullying experiences of weight loss treatment-seeking youth. Pediatrics 2013;131:e1–9.
55. Pearl RL, Puhl RM, Brownell KD. Positive media portrayals of obese persons: impact on attitudes and image preferences. Health Psychol 2012.
56. Berk L, Tan S, Fry W, Napier B, Lee J, Hubbard R, Lewis J, Eby W. Neuroendocrine and stress hormone changes during mirthful laughter. Am J Med Sci 1989;298:390–6.
57. Bohn R, Short J. Measuring consumer information. Int J Commun 2012;6:980–1000.
58. Callahan D. Obesity: chasing an elusive epidemic. Hastings Cent Rep 2013;43:34–40.