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## Research review

Weight stigma is stressful. A review of evidence for the Cyclic Obesity/Weight-Based Stigma model<sup>☆</sup>A. Janet Tomiyama<sup>\*</sup>

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## ABSTRACT

Weight stigma is highly pervasive, but its consequences are understudied. This review draws from theory in social psychology, health psychology, and neuroendocrinology to construct an original, generative model called the cyclic obesity/weight-based stigma (COBWEBS) model. This model characterizes weight stigma as a “vicious cycle” – a positive feedback loop wherein weight stigma begets weight gain. This happens through increased eating behavior and increased cortisol secretion governed by behavioral, emotional, and physiological mechanisms, which are theorized to ultimately result in weight gain and difficulty of weight loss. The purpose of this review is to evaluate the existing literature for evidence supporting such a model, propose ways in which individuals enter, fight against, and exit the cycle, and conclude by outlining fruitful future directions in this nascent yet important area of research.

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## Introduction

How does experiencing prejudice, discrimination, and stigma affect the eating behavior of those who are overweight and obese? This is not a trivial question, as around two-thirds of Americans are either overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014), and obesity is prevalent across much of the world. Answering this question requires an integrated, biopsychosocial research approach guided by strong theory. This review draws from theory in social psychology, health psychology, and neuroendocrinology to construct an original, generative model called the cyclic obesity/weight-based stigma (COBWEBS) model. Weight stigma is defined as the social devaluation and denigration of people perceived to carry excess weight and leads to prejudice, negative stereotyping and discrimination toward those people. This model characterizes weight stigma not as a static construct but rather a “vicious cycle” – a positive feedback loop wherein weight stigma begets weight gain through increased eating and other biobehavioral mechanisms. The goal of this review is to evaluate the existing literature for evidence supporting such a model and to suggest fruitful future directions in this important yet understudied area of research.

Why is research on weight stigma necessary? Although it is less studied, weight stigma is in fact more socially acceptable, severe, and in some cases more prevalent than racism, sexism, and other forms of bias (Brochu & Esses, 2011; Puhl & Heuer, 2009). Indeed, weight stigma has even been described as the last “acceptable” form of bias (Puhl & Brownell, 2001). Overweight individuals are negatively stereotyped, and commonly perceived as lazy, lacking in willpower and control, and unattractive (Brochu & Esses, 2011). Only severe obesity is protected, and only in some cases, by legislation, and so it is not illegal or unlawful for overweight or moderately obese individuals to be denied services or opportunities on the basis of their weight (Puhl & Heuer, 2011; Puhl, Heuer, & Sarda, 2011). There is substantial evidence of weight discrimination across multiple domains of living, including employment (hiring, wages, promotion, and firing), health care, education, and mass media (Puhl & Heuer, 2009). Perhaps the most disheartening examples of weight stigma come from the domain of interpersonal relationships. Children as young as 3 years describe overweight children as “mean,” “stupid,” “lazy,” and “ugly” (Cramer & Steinwert, 1998), and biases based on body size, compared to race and sex, are the most resistant to change to intervention in first- and second-graders (Houlette et al., 2004). Epidemiological studies show overweight and obese children experience up to twice the risk of bullying than normal weight children (Brixval, Rayce, Rasmussen, Holstein, & Due, 2012). In addition to the emotional toll of weight-based stigmatization, it also limits opportunity; for example, parents are less likely to financially support their overweight children, particularly daughters, while attending college (Crandall, 1991, 1995).

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The pervasiveness and insidious nature of weight stigma alone make it worthy of study, but the consequences of weight stigma may even extend to the domain of health. As presented next, experiencing weight stigma may undermine weight loss attempts, and in some cases even contribute to increased weight gain. This likely happens through multiple mechanisms spanning behavior, physiology, and emotion that interact in complex ways. Fortunately, though complex, these interactions are empirically testable.

### The COBWEBS model

The COBWEBS model represents weight stigma as a “vicious cycle,” positive feedback loop (see Fig. 1), and characterizes weight stigma as a stressor. Stress is defined as a negative emotional experience accompanied by predictable biochemical, physiological, cognitive, and behavioral changes that are directed either toward altering the stressful event or accommodating to its effects (Baum, 1990). Experiencing weight stigma is by definition a negative emotional experience, and as the following sections describe, existing research supports predictable biochemical (e.g., cortisol release), physiological (e.g., reward sensitization), cognitive (e.g., decrements in executive function), and behavioral (e.g., eating) changes that accompany it. The two primary mechanisms discussed are (1) eating behavior, and (2) the stress hormone cortisol, a hormone that promotes fat storage and eating behavior. The net effect of this process is to promote weight gain, which then exposes individuals to greater experiences of weight stigma, triggering the cycle again. The following sections review extant evidence for each step of the cycle.

#### Step 1. Weight stigma as a psychological stressor

The model first characterizes weight stigma as a psychological stressor. Returning to the definition earlier, stress is first defined as a negative emotional experience (Baum, 1990). Weight stigma is by definition (i.e., devaluation and denigration) a negative experience, and psychological correlates of weight stigma include increased incidence, risk, and levels of other negative emotional experiences that are stress-related such as depression, anxiety, distress, low self-esteem, and body dissatisfaction (Friedman, Ashmore, & Applegate, 2008; Friedman et al., 2005; Jackson, Grilo, & Masheb, 2000; Puhl & Brownell, 2006; Puhl & Heuer, 2009; Rosenberger, Henderson, Bell, & Grilo, 2007).

A strong literature exists in non-weight domains that characterize social stigma as a stressor (e.g., Inzlicht, McKay, & Aronson, 2006; Major & O'Brien, 2005). Not only is there a large literature studying racial stigma as a stressor (see Pascoe & Smart Richman, 2009; Williams & Mohammed, 2009 for reviews), but stress mechanisms dominate much of the literature attempting to explain racial and other health disparities (e.g., Adler & Rehkopf, 2008).

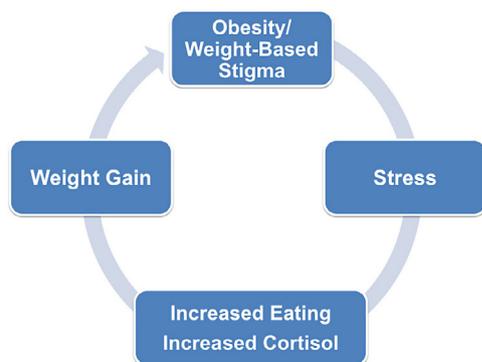


Fig. 1. The vicious cycle of weight stigma.

Similarly, Meyer (2003) posited a model called “sexual minority stress,” linking the stress of sexual minority stigma to increased risk for psychopathology.

Given that weight is another domain of social stigma, weight stigma could plausibly be a form of stress as well. Indeed, others have characterized weight stigma as a potential stressor (Brewis & Wutich, 2012; Major, Eliezer, & Rieck, 2012; Muennig, 2008). Major et al. (2012) tested this idea experimentally in a recent study by exposing individuals to a potentially weight-stigmatizing task. They found that high BMI women in the weight-stigmatizing condition had increased stress perceptions and blood pressure compared to a condition in which weight was not salient. This study drew upon Major and colleagues’ model of Social Identity Threat (see Major & O’Brien, 2005), which characterizes the threat resulting from situations perceived as harmful to one’s social identity as stressful. The COBWEBS model examines what happens as a result of Social Identity Threat in the weight domain, and specifies the resulting downstream eating behavior and physiological cascade of weight stigma, described next.

#### Step 2. Mechanisms of weight stigma stress induced weight gain

The COBWEBS model theorizes that stress induced by weight stigma initiates a cascade of behavioral, emotional, and physiological responses. The modal response in any of these domains causes weight gain, either directly, through stress-induced cortisol secretion, or mediated by coping attempts that promote eating and weight gain. The next sections describe each mechanism and how each promotes weight gain. Although discussed separately, the three mechanisms are of course intertwined.

#### Eating behavior mechanisms

The colloquial term “comfort eating” signifies the importance of food in soothing us in times of stress. Eating is a common comfort-seeking behavioral response to stress and negative emotion (Adam & Epel, 2007; Greeno & Wing, 1994) and is a behavior conserved across species (Dallman et al., 2003). For example, rats randomly assigned to be exposed to chronic restraint stress, cold stress, and other stressors shift their intake from standard rat chow to lard and sucrose (Pecoraro, Reyes, Gomez, Bhargava, & Dallman, 2004). Humans, too, increase their food intake, particularly of high fat and high sugar “comfort foods,” when exposed to stress (Epel, Lapidus, McEwen, & Brownell, 2001; Epel, Tomiyama, & Dallman, 2012). With weight stigma as the stressor, stress-induced eating is the behavioral mechanism that perpetuates the COBWEBS cycle.

Indeed, there is already empirical evidence for the link between weight stigma and eating behavior. Correlational studies suggest that obese individuals exposed to higher levels of weight stigma are more likely to overeat and avoid dieting (see further discussion of dieting later; Myers & Rosen, 1999; Puhl & Brownell, 2006). One study randomly assigned participants to respond to weight stigmatizing questions (proposed to be used for obesity campaigns, such as “Are you happy that your added weight has made many ordinary activities, such as walking up a long flight of stairs, harder?”; Callahan, 2012) or neutral questions about the environment, and found that answering the stigmatizing questions induced higher drive to eat unhealthy, high-calorie, high-sugar foods than answering the control questions (Tomiyama & Mann, 2013).

In the strongest demonstration of the effects of weight stigma on eating behavior, recent experimental studies have measured actual eating behavior as their outcome variable. Major, Hunger, Bunyan, and Miller (2014) randomly assigned women to read an article about overweight individuals experiencing stigma in the employment domain or a neutral article. Those who perceived themselves as overweight consumed more calories in the stigma condition than in the neutral article condition. Schvey, Puhl, and Brownell (2012)

similarly found that overweight women randomly assigned to view a weight-stigmatizing video consumed significantly more calories post-film than those assigned to view a neutral video.

In addition to stress-induced comfort eating, stress can also impair self-regulation. Being the target of discrimination, at least in domains such as racial discrimination, can disrupt self-regulation attempts through depleting the well of self-regulation, known as ego depletion (Inzlicht et al., 2006). Major et al. (2012) found that women high in BMI had decreased executive control compared to those not exposed to weight stigma, and Major, Hunger, Bunyan, and Miller (2014) found that participants exposed to weight stigma reported less dieting self-efficacy than those in the control condition. These studies together provide a foundation of evidence indicating that increased eating behavior may be one response to experiencing weight stigma.

#### *Physiological mechanisms*

The bridging theory that ties social–psychological stress processes to physiological stress processes is the biopsychosocial model of “social-evaluative threat” proposed by Dickerson, Gruenewald and Kemeny (Dickerson, Gruenewald, & Kemeny, 2004; Dickerson & Kemeny, 2004). They argue that of the myriad stressors an individual encounters, social situations containing the potential for negative judgment from others are most likely to engage the stress-responsive hypothalamic–pituitary–adrenocortical (HPA) axis (Dickerson et al., 2004; Dickerson & Kemeny, 2004). Social-evaluative threat and HPA activation ultimately result in elevated secretion of the endocrine stress hormone cortisol. Prolonged exposure to elevated levels of cortisol, in turn, mediates a number of health conditions such as hypertension and cardiovascular disease (Muennig, 2008) and, as will be discussed later, drives eating behavior and fat storage.

Dickerson and Kemeny (2004) found in a meta-analysis that social-evaluative threats are most effective, compared to other stressors with no evaluative component, at eliciting increases in cortisol secretion. Substantial evidence demonstrates that chronically elevated concentrations of cortisol, in turn, ultimately lead to weight gain. Jayo, Shively, Kaplan, and Manuck (1993) manipulated stress in male cynomolgus monkeys and found that monkeys randomly assigned to the stress condition had significantly higher amounts of abdominal fat than non-stressed controls. Cushing’s syndrome, in which body tissues are chronically exposed to excessive levels of cortisol, provides the strongest evidence in humans that elevated cortisol causes weight gain (Shibli-Rahhal, Van Beek, & Schlechte, 2006). Indeed, a hallmark symptom of Cushing’s syndrome is abdominal fat accumulation (Bjorntorp, 2001; Shibli-Rahhal et al., 2006), which is reversed by correcting cortisol levels (Bjorntorp, 2001). The relationship between cortisol and abdominal obesity in the general population is so consistent that researchers have suggested that abdominal obesity be used as an index of long-term increased cortisol (Bjorntorp & Rosmond, 2000).

In addition to its direct effects on fat deposition, cortisol also drives food consumption. It does so directly and by sensitizing the food reward system (Adam & Epel, 2007; Epel et al., 2001; Rudenga, Sinha, & Small, 2012). Humans who are administered glucocorticoids such as cortisol markedly increase their eating (Adam & Epel, 2007; Adam, Schamarek, Springer, Havel, & Epel, 2010), and individuals secreting higher endogenous cortisol levels in response to acute stress in the lab consume more calories subsequently (Epel et al., 2001). Cortisol also sensitizes the reward system, a process governed by interactive connections among stress, the limbic system, basal ganglia, and the prefrontal cortex (Epel et al., 2012). Chronic exposure to cortisol and these mediators results in a state of hedonic withdrawal, which is extinguished with palatable food (Dallman et al., 2003; Epel et al., 2012).

What is not yet entirely clear is whether *weight* stigma specifically elicits a cortisol response; this is one of the least-studied steps of the COBWEBS model. Importantly, however, cortisol secretion does occur in other socially stigmatized domains. For example, Townsend, Major, Gangi, and Mendes (2011) found that, among women high in chronic perceptions of sexism, interacting with an ostensibly sexist man represented a stressor that resulted in increased cortisol secretion. In the weight stigma domain, only two studies have examined cortisol in relation to experiencing weight stigma. Tomiyama and colleagues (2014) documented associations between experiencing weight-stigmatizing events and high weight stigma consciousness and multiple cortisol indices. Schvey, Puhl, and Brownell (2014) randomly assigned lean and overweight women to view a neutral or weight-stigmatizing video. Those viewing the stigmatizing video showed greater cortisol reactivity than those viewing the neutral video, whether overweight or lean. Although further investigation is needed to verify this step, these studies offer preliminary evidence that weight stigma may indeed elicit a cortisol response.

#### *Emotional mechanisms*

Stress appraisals elicit negative emotional responses (Lazarus & Folkman, 1984). While negative emotion in general is important in generating behavioral responses in the COBWEBS model (see prior sections), the specific emotion of shame has key theoretical significance in the model because of its unique ability to elicit cortisol secretion (Dickerson et al., 2004). In an extension of their theoretical model of social-evaluative threat, and drawing on Kemeny’s (2003) integrated specificity model of the psychobiology of stress, Dickerson et al. (2004) emphasized the role of shame as a fundamental emotional response to social threats. They argue that just as the emotion of fear and its resulting physiological cascade evolved to protect us from threats to physical self-preservation, so too did shame evolve to protect us from threats to social self-preservation.

Shame is a key emotional mechanism in the COBWEBS model because overweight and obesity elicit high levels of shame (Conradt et al., 2007). For example, Fredrickson and Roberts’s (1997) objectification theory posits that cultural ideals of female beauty conspire to increase shame, and this is particularly evident among individuals with higher BMIs (Fredrickson, Roberts, Noll, Quinn, & Twenge, 1998). Body shame is not unique to females, with Sanchez, Good, Kwang, and Saltzman (2008) noting the rising trend in male body shame. Shame, in turn, is uniquely effective at engaging the HPA stress axis, and reliably results in increases in cortisol secretion (Kemeny, Gruenewald, & Dickerson, 2004), and thus is central to the COBWEBS model. In sum, substantial evidence ties (a) negative attitudes toward overweight and obese individuals to shame, and (b) shame to cortisol, but the three together have yet to be tested in a single mechanistic model.

The emotion of shame may also come online later in the cycle. Repeated, failed attempts at weight loss (see “Fighting against the cycle” section later) and episodes of overeating may elicit shame, triggering cortisol release again. Shame may also elicit greater weight stigma consciousness, which can then lead to greater experiences of weight stigmatizing events (Kaiser, Vick, & Major, 2006). Stigma consciousness is represented by vigilance or prejudice expectations that then direct attention toward threatening cues, placing an individual at risk for perceiving greater stigmatizing events (Kaiser et al., 2006). Both constant weight stigma consciousness and experiencing stigmatizing events may be stressful, thus perpetuating the cycle.

#### *Step 3. Weight stigma and weight gain*

Might experiencing weight stigma undermine weight loss or even beget weight gain? This question is best answered in longitudinal

studies, as cross-sectional studies pose the risk of reverse causation – that individuals are stigmatized simply because they are overweight. Two recent papers, one in adults and one in children/adolescents, demonstrated a prospective association between experiencing forms of weight stigma and risk of obesity. In a nationally representative sample of over 6000 participants, [Sutin and Terracciano \(2013\)](#) found that non-obese participants who experienced weight discrimination were 2.54 times more likely to be obese at 4-year follow-up than those not experiencing discrimination. Those who started the study obese and also experienced weight discrimination were 3.20 times more likely to have remained obese at follow-up than those not experiencing discrimination. In a child/adolescent sample, a study of over 2000 females found a similar effect: girls who were labeled as “too fat” at age 10 were 1.66 times more likely to be obese at 19, controlling for baseline BMI, compared to those who were not labeled as “too fat” ([Hunger & Tomiyama, 2014](#)). Note that these studies did not test whether psychological stress, cortisol, or eating mediated these relationships, but they are consistent with the COBWEBS framework.

### *Entering, fighting, and exiting the cycle*

If the COBWEBS model is capturing a real phenomenon, then how do individuals move into and out of the COBWEBS cycle? Are all individuals equally vulnerable, or do some respond in ways that facilitate escaping from the cycle? The following sections summarize predictions, based on the literature, for how individuals enter, fight, exit, or re-enter the cycle.

#### *Entering the cycle*

The COBWEBS model originates in psychological processes. Any individual could therefore theoretically fall into the COBWEBS cycle if the psychological conditions are conducive. Weight stigma is highly prevalent ([Puhl & Heuer, 2010](#)) and ideal body size standards are very thin and internalized at ages as young as 3 ([Harriger, Calogero, Witherington, & Smith, 2010](#)). Therefore, the model does not assert that an individual must *physically* be overweight to fall prey to the cycle. The likelihood of experiencing weight stigma may be higher for overweight individuals than thinner individuals, but nonetheless all individuals who feel stigmatized because of their weight could enter the cycle. Congruently, there is a longstanding literature in psychology on subjective construal that demonstrates that perceptions are more important than objective realities ([Griffin & Ross, 1992](#)), and perceptions of weight specifically appear to be particularly malleable. Data from a nationally representative sample ([Chang & Christakis, 2001](#)) found that self-evaluations of weight were discordant with objective weight 29% of the time. The BMI cutoff for overweight is 25, but women consider themselves overweight at approximately 23, which is well within the range for normal weight ([Crawford & Campbell, 1999](#)). Similar effects emerge among observers, who believe that the average female body is actually a thin shape that does not exist in nature ([Johnson, Iida, & Tassinary, 2012](#)). As evidenced by the study by [Major and colleagues \(2014\)](#), the perception of oneself as overweight is important when considering the consequences of weight stigma, and individuals who are not objectively overweight or obese may still fall prey to stigma processes. However, stigma effects may be stronger for women because weight stigma is directed more strongly against women in a multitude of situations such as employment and interpersonal relationships, and stigma processes operate at lower levels of weight for women compared to men ([Puhl, Andreyeva, & Brownell, 2008](#); [Puhl & Heuer, 2009](#)). Therefore, it is possible that individuals who perceive themselves as overweight and perceive weight stigma could in fact enter and re-enter into the cycle.

#### *Fighting against the cycle*

In the face of weight stigma, not all individuals are likely to respond solely by increasing their eating to cope with weight stigma stress. Individuals may (a) undertake behaviors or (b) engage in psychological coping processes to attenuate the effects of weight stigma. Dieting, or changing food intake for the purposes of weight loss, may be a behavioral response to experiencing weight stigma. However, reviews of long-term outcomes of dieting (e.g., [Mann et al., 2007](#); [Tomiyama, Ahlstrom, & Mann, 2013](#)) conclude that weight loss is not, on average, a common outcome of dieting. Dieting can also directly stimulate cortisol release, and is a causal factor in both psychological stress and cortisol ([Tomiyama et al., 2010](#)). Therefore, dieting in response to weight stigma stress may be an unsuccessful coping avenue for many. Furthermore, [Major and colleagues \(2014\)](#) found that exposure to weight stigma decreased self-efficacy for dietary control, indicating that individuals may not persist in their dieting efforts or attempt to diet.

In addition to these behavioral coping efforts, individuals may also engage in psychological coping efforts, but these may also be unsuccessful avenues in the context of weight stigma. [Major and O'Brien \(2005\)](#) provided an integrated theoretical model of stigma-induced identity threat, drawing on research from the domains of stigma from race, gender, and sexual orientation. In their model, they focus on three main psychological coping strategies. The first is attributing negative events to unfair discrimination, which is likely difficult for overweight individuals because weight bias can be more socially acceptable than racism, sexism, and many other forms of bias ([Brochu & Esses, 2011](#); [Crandall, Eshleman, & O'Brien, 2002](#)). In fact, [Crocker, Cornwell, and Major \(1993\)](#) provided evidence that overweight individuals do not attribute negative feedback to discrimination. The second psychological coping strategy is identifying more closely with the threatened group. In the context of weight, however, overweight individuals tend to internalize weight bias ([Crandall, 1994](#); [Crocker et al., 1993](#); [Wang, Brownell, & Wadden, 2004](#)). Positive identification with overweight others is rare (but see discussion of the fat acceptance movement later), and it does not help to lessen the feeling of threat even when positive identification does occur ([Schafer & Ferraro, 2011](#); [Wang et al., 2004](#)). The third psychological coping strategy is disengaging self-esteem from threatening domains. Overweight individuals, however, typically do not glean positive esteem from their weight-based group identities in the first place ([Crandall, 1994](#); [Wang et al., 2004](#)). If the threatening domain is exercise or eating, then disengaging from these domains would further promote sedentary behavior and unhealthy eating ([Vartanian & Novak, 2011](#); [Vartanian & Shaprow, 2008](#)). Many psychological coping mechanisms, therefore, may be either unavailable or ineffective in the context of weight stigma, thus promoting cycle re-entry.

#### *Exiting the cycle*

Exiting the cycle is likely difficult, but there are three main ways that one could potentially do so. First, individuals could lose weight and keep it off. This is a tall order, as dieting is ineffective ([Mann et al., 2007](#); [Tomiyama et al., 2013](#)), stressful ([Tomiyama et al., 2010](#)), and those who do succeed at long-term weight loss and maintenance have unique psychosocial profiles that often are trait-like and difficult to change ([Incollingo Belsky, Epel, & Tomiyama, 2014](#)). Exercise may be a promising way to exit the cycle, as it promotes weight loss, reduces stress ([Salmon, 2001](#)), and improves body image, even in the absence of body shape and weight change ([Appleton, 2013](#)). However, weight stigma is linked to exercise avoidance ([Vartanian & Novak, 2011](#); [Vartanian & Shaprow, 2008](#)).

A second way of exiting the cycle, given the apparent importance of perceived weight, is to change self-perceptions of weight. This may be difficult, as poor body image is considered a

“normative discontent” (Rodin, Silberstein, & Striegel-Moore, 1984), not just for women but also now for men (Tantleff-Dunn, Barnes, & Larose, 2014), and therefore thoughts about one’s own weight are likely entrenched. However, recent fat acceptance movements such as Health at Every Size (Bacon, 2010) have shown promise for improved health and psychological well-being (Bacon et al., 2002; Provencher et al., 2009).

Finally, there is a physiological upper limit to one’s weight due to genetic factors and human physiology, and therefore likely a physiologically constrained upper limit to the COBWEBS cycle. If an individual is at the maximum of their physiologically possible weight, the feed-forward process may be terminated. However, COBWEBS processes may inhibit weight loss efforts, for the reasons noted earlier. In sum, the unique nature of weight stigma and the factors reviewed earlier may conspire to make re-entry into the cycle the modal response.

#### Step 4. Weight gain and weight stigma. A positive feedback loop?

The final step of the COBWEBS model contends that the weight gain incurred from the stress of weight stigma exposes an individual to increased levels of stigma in the future – a positive feedback loop. This is another understudied part of the model. One way to test this would be to examine whether a linear relationship exists between increases in weight and increases in weight stigma for individuals who are already overweight or obese. Although several studies exist that document cross-sectional associations between weight and weight stigma (e.g., Drury, Louis, & Alegria Drury, 2002; Puhl & Brownell, 2006; Vartanian & Novak, 2011), this does not speak to the positive feedback nature of the model. Future research using longitudinal designs and dynamic systems modeling (Aschbacher et al., 2012; Aschbacher & Kemeny, 2011) are necessary to determine whether COBWEBS processes truly increase risk for further stigma, or whether these are simply static relationships. Relatedly, future research must test whether the processes described in the model are truly obesogenic or simply hinder weight loss efforts. If the latter, then the stress of weight stigma may lead instead to a maintenance of the cycle rather than a positive feedback loop. These competing hypotheses are ripe for future study.

#### Model summary and future research

The COBWEBS model asserts that weight stigma is a stressor that will elicit reliable behavioral, physiological, and emotional responses that ultimately result in weight gain or difficulty of weight loss. Whether these responses are automatic responses to stress or deliberate coping attempts, increased eating and cortisol-mediated weight gain are theorized to occur, thus exposing individuals to more weight stigma. This triggers the vicious cycle again, rendering individuals to be, figuratively, stuck in the COBWEBS.

Future research would benefit from first focusing on the following predictions of the model. Causal data tying together all of the first three components – weight stigma, stress, and eating/cortisol – are necessary, as the literature examining stress and its effects on eating is relatively established, and the literature examining the effects of stress on cortisol is now firmly established. Psychological stress, eating behavior, and cortisol secretion can all be examined in the context of a single study. Therefore, laboratory-based, randomized experiments that manipulate weight stigma, measure eating behavior and cortisol as outcomes, and test whether psychological stress mediates the relationship are a clear first step. Similarly, the literatures tying eating behavior and cortisol to weight gain are well established and are therefore lower priority from a COBWEBS standpoint. Longitudinal studies that carefully map the mechanistic steps of the model, and most critically test the cyclic nature – does weight stigma beget more weight gain, and there-

fore more stigma? – are an important next step. These studies should also test for threshold effects – how much weight stigma does one need to experience to gain weight?

Finally, intervention studies that reduce perceptions of weight stigma will inform efforts to potentially break the cycle. Conducting successful intervention studies will require careful, nuanced strategies, as the evidence is mixed regarding whether treating weight and obesity stigma can improve psychological and physiological outcomes. Some fat acceptance interventions, notably size acceptance interventions such as those based on the Health at Every Size movement, have shown to improve health even in the absence of weight loss, and are therefore a promising tool (Bacon, 2010; Bacon, Stern, Van Loan, & Keim, 2005; Carroll, Borkoles, & Polman, 2007; Provencher et al., 2009). Similar interventions have also yielded positive weight (Anglin, 2012; Gagnon-Girouard et al., 2010; Lillis, Hayes, Bunting, & Masuda, 2009; Rapoport, Clark, & Wardle, 2000; Tanco, Linden, & Earle, 1998), fitness (Carrier, Steinhardt, & Bowman, 1994) and psychological outcomes (Ciliska, 1998; Gagnon-Girouard et al., 2010; Lillis et al., 2009; Omichinski & Harrison, 1995; Tanco et al., 1998). However, some interventions that target weight stigma have found no significant benefits, such as one that targeted internalized weight bias, which found no benefit over an environmental modification and habit formation disruption intervention (Carels et al., 2014), and some longitudinal studies found that higher weight stigma is associated with better weight loss outcomes (e.g., Latner, Wilson, Jackson, & Stunkard, 2009). Yet other interventions are currently being conducted, and their results when available will also inform intervention efforts (e.g., Tirlea, Truby, & Haines, 2013).

#### Significance

Given the high prevalence of overweight and obesity in this nation, the processes governing weight stigma have the potential to affect millions of Americans. If theoretical predictions from the COBWEBS model are substantiated by future research, we may then have further understanding of why obesity remains such an intractable problem: obesity stigma begets increased eating and fat deposition, and is therefore a hurdle to weight loss. As such, future behavioral nutrition treatments may require treating the experience of stigma in addition to reducing adiposity. Public health and public policy messages about obesity may also be in order to help to reduce stigma and shift public discourse away from emphasizing weak discipline or blaming the victim. Specifically, the COBWEBS model informs a larger debate occurring in the arena of the obesity epidemic. Some contend that weight stigma is the answer for solving the obesity epidemic, with the rationale that stigmatizing individuals will increase their awareness of the problem and motivation to lose weight. For example, prominent health policy scholar Daniel Callahan has advocated the use of “stigmatization lite” to socially pressure individuals to understand “that excessive weight and outright obesity are not socially acceptable any longer” (Callahan, 2012, p. 37). Indeed, such anti-obesity campaigns are already being implemented on large scales, such as the state of Georgia’s Strong4Life campaign (Teegardin, 2012) that used stigmatizing images and messages regarding obese children. However, the potentially deleterious nature of weight stigma and its relevance to public health was examined in a review paper by Vartanian and Smyth (2013). They concluded that using weight stigma as an anti-obesity strategy violates the medical principle of *primum non nocere*, or “first do no harm.” The COBWEBS model further provides scientific theory and evidence that suggest that such campaigns will likely be ineffective, and perhaps even backfire.

How does the COBWEBS model represent an advancement over a general model of stress and weight gain? There are three key contributions of the model that further such a general model. First, the model identifies weight stigma specifically as a source of stress that

may have deleterious consequences in its own right; general models of stress and weight are silent as to the source of stress (Baum, 1990; Bjorntorp, 2001; Lazarus & Folkman, 1984). As a result, the model, which also identifies the most salient mechanisms, allows for tailored interventions. An intervention based on the COBWEBS model would, for example, look different from an intervention designed to combat the stress of racism, despite the fact that both would fall under a general model of stress and weight. The ability to specify interventions is important because, second, the model highlights that normal coping responses – which would in a general model of stress and weight be effective ways to dampen stress effects (Lazarus & Folkman, 1984; Major & O'Brien, 2005) – are likely not available in the context of weight stigma specifically. Third, general models of stress and weight are not commonly theorized to be cyclic in nature.

The COBWEBS model may also inform general social psychological theories of stigma, because weight stigma is also a theoretically provocative deviation from traditionally stigmatized social identities. Overweight and obese individuals form a numerical majority in the United States (Ogden et al., 2014) but are nevertheless stigmatized as if they were a minority group. Furthermore, weight is commonly considered controllable, and people attribute responsibility to and thus blame overweight individuals for their weight status unlike in the case of racial minorities or women (Crandall, 1994; Weiner, Perry, & Magnusson, 1988). The fact that humans must eat to survive makes weight stigma unique, as eating itself may be a context for stigmatization, providing multiple, repeated, daily opportunities for experiencing weight stigma. There is no in-group favoritism among overweight individuals as they themselves tend to internalize weight bias, show implicit attitudes that prefer thin individuals to fat individuals, and typically do not glean positive esteem from their weight-based group identities (Crandall, 1994; Crocker et al., 1993; Rudman, Feinberg, & Fairchild, 2002; Schwartz, Vartanian, Nosek, & Brownell, 2006; Wang et al., 2004). Moreover, the greatest weight stigmatization comes from family members and close friends – people who would typically be unconditional sources of social support and safety (Puhl & Brownell, 2006). Weight-specific theories of stigma, therefore, are needed.

Cortisol is a central mechanism in the COBWEBS model that promotes eating behavior and fat deposition. Elevated cortisol also mediates known stress-related health conditions, including hypertension, type II diabetes, and cardiovascular disease which notably are the same conditions found most often in obese individuals (Muennig, 2008). This overlap observed between health conditions activated by stressors on the one hand and obesity on the other suggests that weight stigma may even be “salt in the wound” contributing to the pathophysiology of obesity (Tomiyama et al., 2014). In other words, it may be that a portion of the negative health consequences of obesity can be attributed to stigma rather than simply obesity *per se*.

Given the current climate of widespread bias, evidence generated from the COBWEBS model will underscore the importance of reframing weight stigma as a risk factor for overeating, weight gain, and a barrier to weight loss, justifying efforts to decrease stigma, discrimination, and prejudice against individuals considered to be overweight or obese. The ultimate goal of COBWEBS model, which integrates theory from social psychology, health psychology, and neuroendocrinology, is to generate hypotheses and research with broader impacts that are urgently needed at a time when diseases of overconsumption are widespread and weight stigma is rampant.

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