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Association of Weight Discrimination During Pregnancy and Postpartum With Maternal Postpartum Health

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Objective: Weight stigma adversely affects the health of the general population, but almost no studies have examined possible negative consequences of weight stigma in the context of pregnancy. The present study tested whether experiencing weight stigma in pregnancy is inversely related to mental and physical health in mothers during the first postpartum year. ***Method:*** This study examined associations between weight-related experiences of discrimination in everyday life, measured at 1 month after the birth of a child, and physical and mental health outcomes measured concurrently and at 6 months and 1 year postpartum in a sample of 214 women in the Community Child Health Network study. Outcomes of interest were postpartum depressive symptoms, pregnancy weight gain, postpartum weight retention, and two biomarkers of maternal stress (blood pressure and salivary cortisol). ***Results:*** After adjusting for covariates including race/ethnicity and prepregnancy body mass index, weight-related everyday discrimination was associated with greater postpartum depressive symptoms at 1 month postpartum. Weight-related everyday discrimination was also associated with greater pregnancy weight gain and greater weight gain in excess of the recommendations set by the Institute of Medicine. Additionally, weight-related discrimination prospectively predicted greater postpartum depressive symptoms and weight retention at 1 year postpartum. Weight-related everyday discrimination was not associated with blood pressure or cortisol. ***Conclusions:*** These findings offer novel evidence that experiencing weight stigma during pregnancy and in the early postpartum period is prospectively associated with adverse mental and physical health outcomes for women after birth, implicating weight stigma as a potential maternal health threat.

Keywords: weight stigma, maternal health, postpartum depression, gestational weight gain, stress physiology

Pregnancy is a time of tremendous physical and psychological change (Hamilton & Lobel, 2008). During this period, a variety of social factors can influence maternal health, both positively and negatively. One such factor that may have a meaningful impact yet has received very little attention is weight stigma. Weight stigma, also called weight bias or weight-based discrimination, is defined as bias or discrimination targeted toward individuals who are perceived to be heavy, overweight, or obese (Puhl & Brownell, 2001). This form of stigma is frequently reported by individuals with overweight and obesity, where, for example, nonpregnant heavy women report experiencing weight stigma, on average, three times each day (Seacat, Dougal, & Roy, 2016).

The literature on the consequences of experiencing weight stigma in nonpregnant individuals is rapidly growing. There is

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mounting evidence from nationally representative samples that experiencing weight stigma is prospectively associated with adverse health outcomes and mortality in adult women and men (Sutin, Stephan, & Terracciano, 2015). Many of these health outcomes are particularly relevant for pregnancy; for instance, weight stigma is associated with reports of more depressive symptoms and increased risk of diagnoses of major depressive disorder (Papadopoulos & Brennan, 2015). Moreover, weight stigma has been shown to undermine attempts to lose weight (Papadopoulos & Brennan, 2015) and, paradoxically, drives weight gain instead (Jackson, Beeken, & Wardle, 2014; Sutin & Terracciano, 2013). Finally, there is evidence from laboratory studies that weight stigma elicits physiological reactivity via increased cortisol and blood pressure (Himmelstein, Incollingo Belsky, & Tomiyama, 2015; Major, Eliezer, & Rieck, 2012; Puhl & Suh, 2015; Schvey, Puhl, & Brownell, 2014).

These outcomes in the context of pregnancy—for example, postpartum depressive symptoms, excess gestational weight gain and postpartum weight retention, and maternal physiological stress reactivity—are pertinent to healthy pregnancies because they all can have implications for maternal and child health, not only during pregnancy, but during the postpartum period as well (e.g., Davis & Sandman, 2010; Endres et al., 2015; Gress-Smith, Luecken, Lemery-Chalfant, & Howe, 2012; Hobel, Dunkel-Schetter, Roesch, Castro, & Arora, 1999; Johnson et al., 2013; Moehler, Brunner, Wiebel, Reck, & Resch, 2006). Evidence of whether weight stigma elicits these consequences in the context of pregnancy, though, is limited. One study from the broader discrimination literature did find that discrimination attributed to race or weight was related to a heightened risk of gaining excess weight over the course of pregnancy among 413 Black and Latina women (Reid et al., 2016). Despite the strength of using a diverse sample, this study looked at all forms of discrimination, and current research has not addressed whether weight stigma in particular might be associated with the abovementioned maternal health consequences. This gap in research is notable because all pregnant women must gain weight, and roughly 22% of women begin pregnancy already with obesity by current body mass index (BMI) standards (Kim, Dietz, England, Morrow, & Callaghan, 2007). Moreover, weight stigma can affect any woman who perceives herself to be heavy, regardless of her objective BMI (e.g., Himmelstein et al., 2015; Incollingo Rodriguez, Heldreth, & Tomiyama, 2016; Major, Tomiyama, & Hunger, 2018), which suggests that all pregnant women may be vulnerable to weight stigma and its consequences.

The current study aimed to address this lack of knowledge on weight stigma in maternal health by testing a priori hypotheses using data collected by the Community Child Health Network (CCHN) study. This multisite community-based project investigated factors contributing to disparities in maternal-child health. Based on the existing literature linking weight stigma to the abovementioned outcomes in nonpregnant populations, the present study tested the following hypotheses in a diverse sample of women: more frequent experiences of weight stigma would be associated with (Hypothesis 1) more postpartum depressive symptoms throughout the first year postpartum, (Hypothesis 2) more gestational weight gain and excess weight gain as well as postpartum weight retention, and (Hypothesis 3) higher cortisol and blood pressure over the postpartum period.

Method

CCHN Study Design

CCHN was a five-site research network funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development. This network conducted a collaborative, community participatory study with the goal of reducing racial, ethnic, and socioeconomic disparities in maternal-child health. The network/study sites were Baltimore, Maryland; Los Angeles, California; Washington, DC; Lake County, Illinois; and several counties in Eastern North Carolina, each of which had a designated catchment area serving low-income and racially and ethnically diverse pregnant populations. Full information on recruitment, enrollment, and data collection procedures in the CCHN study along with detailed demographic and descriptive information about the study sample are published elsewhere (see Dunkel Schetter et al., 2013; O'Campo et al., 2016; Ramey et al., 2015). In brief, this longitudinal study collected data from Black, Latina, and non-Hispanic White women from 1 month after the birth of a child at regular intervals for 2 years, and a subset who conceived again were followed throughout the subsequent pregnancy, birth, and at one interval postpartum. The study was approved by the institutional review boards of all participating universities and community organizations, and written informed consent was obtained from all participants. The dataset includes information abstracted from medical records, biospecimens, and biophysical measures. Trained study staff conducted home visits to collect semistructured interview data with participants at 1 month, 6 months, and 1 year postpartum and collect other data. CCHN is now a public use dataset.

Participants

The full CCHN study sample was composed of 2,510 women aged 18 to 40 who delivered a live infant at 20 or more weeks of gestation. Most participants were enrolled while still in the hospital after delivering their child, with the exception of one site that enrolled participants during their pregnancies.

The present study used a subsample of 214 participants who completed the everyday discrimination measure and selected "height or weight" as the reason to which they attributed their everyday experiences of discrimination. This represents approximately 13% of the full study sample. Overall, demographic characteristics in this sample closely paralleled the full sample with no statistically significant differences on age, ethnicity, education, or poverty status (all $ps > .16$). Table 1 presents comparisons between this sample and the full sample.

Measures

Predictor variable.

Weight-related discrimination. Experiences of weight stigma were assessed at 1 month postpartum using the original nine items in the Everyday Discrimination Scale (Williams, Yan, Jackson, & Anderson, 1997). Sample items are "you are treated with less courtesy than other people" and "you are threatened or harassed." A tenth item ("You are followed around in stores") was later added to this scale specifically to capture racial discrimination (Williams

Table 1
Comparison of Demographic Characteristics Between Full and Subsamples

Variable	Full sample, $N = 2{,}510$	Subsample, $n = 214$	χ^2 or t	p value
Age	25.68 (5.67)	25.24 (5.55)	1.15	.251
Ethnicity			.31	.858
Black	53.7%	50.5%		
Latina	22.1%	23.4%		
White	24.2%	26.2%		
Education			1.80	.772
Less than high school	18.7%	20.6%		
High school or equivalent	42.8%	47.2%		
Some college	22.5%	19.2%		
Bachelor's degree or equivalent	14.8%	12.1%		
Other	1.2%	.9%		
Poverty status			3.61	.165
At or below the federal poverty line	43.0%	52.3%		
100%–200% of the federal poverty line	27.4%	21.1%		
>200% of the federal poverty line	29.6%	26.6%		

Note. Unless displayed with a % symbol, values refer to means, and standard deviations are in parentheses. White = non-Hispanic White.

et al., 2008), and accordingly, this item was dropped in the present analyses. Participants responded indicating how frequently each type of discriminatory experience occurred over the previous year, from *almost every day* to *never*. Participants also indicated to what they attributed these discriminatory experiences, selecting from a list of nine possible reasons for their experiences such as race, accent, nationality and others. One option on this list was "your height or weight." Any participant who completed the scale and endorsed her height or weight as the reason for her experiences of discrimination, even if she also selected additional reasons, was designated as having experienced weight stigma during pregnancy and/or the early postpartum period. This measure was used as the predictor in all analyses. Cronbach's alpha = .88 for the nine-item version of this scale in this sample, and $\alpha = .83$ for the 10-item version.

Outcome variables.

Postpartum depression. Postpartum depressive symptoms were assessed at 1 month, 6 months, and 1 year postpartum using the validated Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987). The EPDS has demonstrated strong psychometric properties in previous research among postpartum women (e.g., Cox et al., 1987), including good reliability (Cronbach's alpha = .87) and established validity, and it is sensitive to depressive symptom fluctuations. Participants indicated how frequently 10 common postpartum depressive symptoms occurred over the previous 7 days. In this sample, Cronbach's alpha reliability = .77 at 1 month postpartum, $\alpha = .79$ at 6 months postpartum, and $\alpha = .79$ at 1 year postpartum.

Prepregnancy and postpartum BMI. Prepregnancy weight and height were recorded in medical records, whereas postpartum weight and height were measured by study staff during home visits at 6 months and 1 year postpartum. Weight was measured in pounds using a UC-321 Precision Personal Health (Milpitas, CA) digital scale. Height was measured in inches using a rigid measuring tape as participants stood against a wall without shoes. BMI at each time point was then calculated according to the standard formula of weight[kg]/height^2[m]. The average prepregnancy BMI for participants was 30.34 kg/m^2 ($SD = 8.31$). At 6 months postpartum, the mean BMI was 32.06 kg/m^2 ($SD = 9.07$), and at 1 year postpartum, the mean BMI was 32.21 kg/m^2 ($SD = 9.23$). BMI values were also categorized according to the Institute of Medicine cutoffs for individuals with "underweight" (<18.5 kg/m^2), "normal weight" (18.5–24.9 kg/m^2), "overweight" (25.0–29.9 kg/m^2), and "obesity" (≥30.0 kg/m^2).

Pregnancy weight gain. Pregnancy weight gain was calculated as the difference between the participant's prepregnancy weight and weight at delivery as recorded on medical charts in pounds. A total of 149 out of the 214 participants had complete data to compute this variable; for this group, the mean pregnancy weight gain was 29.77 pounds ($SD = 16.83$).

Excess gestational weight gain. Excess gestational weight gain was calculated as the amount of weight gain beyond the Institute of Medicine's maximum recommendation based on prepregnancy BMI classification (Institute of Medicine & National Research Council, 2009), which is 35 pounds for underweight and normal weight BMI, 25 pounds for overweight BMI, and 20 pounds for obese BMI. A total of 49% gained within the recommended range, while 51% had excess weight gain. The average amount of excess weight gain was 3.63 pounds ($SD = 17.39$). These values are roughly comparable to the national average rate of excess weight gain, which has been reported at 47% in population-based samples (Deputy, Sharma, Kim, & Hinkle, 2015).

Weight retention. Participant weight was measured during home visits at 6 months and 1 year postpartum and weight retention was calculated as the difference between a participant's weight at each interview time point and her prepregnancy weight, when prepregnancy weight was available. The average weight retention was 10.47 pounds ($SD = 20.19$, $n = 86$) at 6 months postpartum and 10.21 pounds ($SD = 20.27$, $n = 98$) at 1 year postpartum.

Blood pressure. Systolic and diastolic blood pressure readings (mmHg) were taken during the 6-months and 1-year postpartum visits while the participants were seated using an Omron HEM-

711DLX or HEM-907XL Pro standardized digital sphygmomanometer (Omron Global, Osaka, Japan). At each time point, averages of the three measures were computed for analyses.

Cortisol. At both 6 months and 1 year postpartum, participants completed 1 day of diurnal salivary cortisol sampling during which they provided saliva samples upon waking, 30 min after waking, and at bedtime. Three variables were computed at each time point: cortisol awakening response (computed as the difference between the two morning values), cortisol slope (computed from the morning and evening values), and total daily cortisol output (computed as the area under the curve).

Covariates.

Demographic covariates. A set of demographic variables were collected through interviews: mother's age at enrollment, years of education, per capita household income adjusted for cost of living, race and ethnicity (Black, Latina, non-Hispanic White), and cohabitation status with the child's father (not cohabiting, unmarried but cohabiting, married and cohabiting).

Pregnancy- and health-related covariates. Pregnancy- and health-related measures included prepregnancy BMI, primiparity, type of delivery (vaginal vs. C-section), length of interpregnancy interval (weeks), whether mother was breastfeeding at each time point, hormonal contraception use, and steroid medication use.

Data Analytic Plan

Hierarchical linear regression analyses were employed to evaluate everyday discrimination as a continuous predictor of outcomes for each hypothesis. Potential covariates (age at enrollment, years of education, income, cohabitation status, prepregnancy BMI, breastfeeding status at the analytic time point, type of delivery, parity at time of delivery, interpregnancy interval, study site) were first tested to ensure they were not associated with everyday discrimination (the predictor). Covariates were then tested for potential associations with each of the outcomes of interest. In the event that any covariate was significantly related to any outcome, this covariate was then entered into all models for the related hypothesis. Thus, each set of analyses for a given hypothesis had a different set of covariates.

The race/ethnicity variable (Black/Latina/non-Hispanic White) was related to everyday discrimination, $F(2, 209) = 3.22$, $p = .042$, with post hoc analyses revealing that Black participants scored marginally significantly higher than non-Hispanic White participants, $p = .070$. The interaction between everyday discrimination and the race/ethnicity variable did not affect any outcome of interest (all ps $> .211$). Therefore, two variables coding race/ethnicity were included as covariates in the first step of all models. Because some women attributed their discrimination to other sources in addition to weight, a dichotomous variable coding whether multiple attributions had been made was also entered as a covariate for all analyses. Although the weight attribution includes "height," everyday discrimination values were not significantly related to participants' height, $p = .767$, nor did height affect results, and participant height was therefore not included. In sum, all models included the race/ethnicity variables and if multiple attributions were made along with any unique covariates that emerged as significant per the individual hypothesis.[1]

Results

The study sample was comprised of roughly 54% Black participants, 22% Latina participants, and 24% non-Hispanic White participants. This group was primarily low income, with 43% living at or below the federal poverty line, and 43% were also classified as having prepregnancy obesity by BMI standards. Black and Latina participants were younger, less educated, and had lower household income per capita than non-Hispanic White participants. Table 2 presents descriptive statistics and comparisons by race/ethnicity on the predictor variable, outcome variables, and covariates.

H_1: Postpartum Depressive Symptoms

In addition to race/ethnicity and multiple attributions, the following covariates were included in the analyses for this hypothesis: mother's age and previous postpartum depressive symptoms (for analyses on measures at 6 months and 1 year postpartum).

Results of the hierarchical regression analyses for each outcome are reported in Table 3. Weight-related everyday discrimination predicted more postpartum depressive symptoms at both 1 month and 1 year postpartum, controlling for the specified covariates, but was not significantly associated with postpartum depressive symptoms at 6 months postpartum.

H_2: Weight-Related Outcomes

In addition to race/ethnicity and multiple attributions, the following covariates were included in the analyses for this hypothesis: mother's age and primiparity.[2]

Results of hierarchical regression analyses for each outcome are reported in Table 4. Weight-related everyday discrimination was associated with greater gestational weight gain and excess gestational weight gain and also predicted more weight retention at 1 year postpartum, controlling for covariates. It was not significantly associated with weight retention at 6 months postpartum.

H_3: Physiological Outcomes

In addition to race/ethnicity and multiple attributions, the following covariates were included in the analyses for this hypothesis: mother's age, mother's education, and C-section delivery. Hormonal contraception and steroid medication use were examined as potential covariates as these can influence cortisol, but neither was significant. These were therefore excluded as covariates.

[1] Although prepregnancy BMI was not determined as statistically appropriate to include as a covariate in any models, separate analyses were also conducted controlling for this variable. Including this covariate did not affect the statistical significance for any outcome with the exception of weight retention at 1 year postpartum, where the relationship was reduced to marginal statistical significance, $p = .096$.

[2] There were differences in weight retention based on study site. Namely, participants from Baltimore had greater weight retention than those from Los Angeles or Washington, DC at 6 months postpartum ($p = .005, .024$, respectively) and more than those from Los Angeles at 1 year postpartum ($p = .037$). These comparisons, though, were underpowered ($n < 18$ for all sites except Chicago). Additionally, weight retention was the only outcome for which there were differences by site. Site was therefore excluded as a covariate; the significance of results did not change when controlling for site.

Table 2
Descriptive Statistics and Comparison by Race/Ethnicity on Variables of Interest

Variable	Overall (N_{total} = 214)	Black (n = 108)	Latina (n = 50)	White (n = 56)	Test statistic	p value	Tukey post hoc
Predictor variable							
Everyday discrimination	14.24 (7.20)	15.47 (7.56)	13.14 (8.19)	12.86 (4.95)	F = 3.22	.042	a > c†
Endorsed multiple attributions	82.2%	79.6%	90%	80.4%	χ^2 = .80	.670	
Hypothesis 1							
Postpartum depressive symptoms							
1 month postpartum	6.11 (4.43)	6.50 (4.86)	5.90 (4.09)	5.56 (3.84)	F = .86	.423	
6 months postpartum	5.71 (4.41)	6.44 (4.58)	5.59 (5.03)	4.67 (3.54)	F = 2.29	.105	
1 year postpartum	5.14 (4.41)	4.94 (4.77)	5.94 (3.77)	4.88 (4.19)	F = .70	.500	
Hypothesis 2							
Pregnancy weight gain (pounds)	29.77 (16.83)	31.82 (19.65)	28.28 (14.78)	28.16 (13.89)	F = .83	.437	
Excess weight gain (pounds)	3.63 (17.39)	5.93 (19.95)	1.73 (15.89)	2.16 (14.41)	F = .96	.384	
Weight retention							
6 months postpartum	10.47 (20.19)	14.20 (23.72)	8.66 (16.21)	7.81 (18.53)	F = .92	.401	
1 year postpartum	10.21 (20.27)	12.69 (19.35)	12.16 (22.38)	5.52 (19.40)	F = 1.28	.282	
Hypothesis 3							
Systolic blood pressure							
6 months postpartum	112.33 (13.63)	115.54 (14.75)	107.27 (12.25)	110.80 (11.71)	F = 3.99	.021	a > b*
1 year postpartum	112.03 (12.87)	113.50 (15.09)	108.98 (10.84)	111.64 (9.40)	F = 1.31	.274	
Diastolic blood pressure							
6 months postpartum	75.83 (12.09)	78.53 (14.02)	70.96 (9.82)	75.04 (9.27)	F = 3.84	.024	a > b*
1 year postpartum	74.28 (10.11)	75.72 (11.21)	70.39 (9.81)	74.53 (7.46)	F = 2.96	.055	a > b*
Total cortisol output (μg/dL)							
6 months postpartum	5.23 (2.68)	5.54 (3.67)	4.30 (2.16)	5.47 (1.89)	F = 1.34	.269	a < c†
1 year postpartum	4.97 (3.62)	4.09 (2.19)	4.20 (2.37)	6.34 (4.90)	F = 3.30	.043	
Cortisol awakening response (μg/dL)							
6 months postpartum	.03 (.32)	−.04 (.40)	−.01 (.31)	.09 (.27)	F = 1.14	.325	
1 year postpartum	.02 (.29)	−.08 (.27)	.03 (.21)	.13 (.33)	F = 2.93	.062	a < c*
Cortisol slope							
6 months postpartum	−.02 (.03)	−.02 (.04)	−.03 (.02)	−.03 (.02)	F = .47	.625	
1 year postpartum	−.02 (.02)	−.02 (.02)	−.02 (.02)	−.03 (.02)	F = .25	.782	
Covariates							
Age at enrollment (years)	25.24 (5.55)	23.70 (4.58)	24.18 (4.68)	29.17 (6.14)	F = 23.05	<.001	a < c*** b < c***
Education (years)	12.69 (2.60)	12.44 (1.90)	11.02 (2.37)	14.66 (2.75)	F = 35.56	<.001	a > b*** a < c** b < c***
Household income per capita (in thousands of dollars)	12.14 (18.95)	8.52 (12.42)	5.92 (7.09)	24.55 (28.72)	F = 19.88	<.001	a < c*** b < c***
Cohabiting with father 1-year postpartum	53.7%	32.4%	70%	80.4%	χ^2 = 21.14	<.001	
Study site					χ^2 = 135.66	<.001	
Baltimore, MD	14%	24.1%		7.1%			
Chicago, IL	25.2%	8.3%	46%	39.3%			
Los Angeles, CA	18.7%	9.3%	40%	17.9%			
Eastern North Carolina	18.5%	21.3%		30.4%			
Washington, DC	23.4%	37%	14%	5.4%			
Prepregnancy BMI (kg/m^2)	30.34 (8.31)	30.66 (9.08)	29.78 (7.02)	30.43 (8.53)	F = .10	.906	
Prepregnancy BMI categories							
Underweight/normal weight	33.3%	35.4%	31.1%	32.5%	χ^2 = 9.11	.058	
Overweight	23.3%	13.8%	37.8%	22.5%			
Obese	43.3%	50.8%	31.1%	45%			
Multiparous	55.4%	58%	59.2%	47.2%	χ^2 = 1.62	.444	
C-section delivery	45.9%	46.1%	34.0%	56.6%	χ^2 = 5.80	.055	
Interpregnancy interval (months)	18.87 (10.67)	14.91 (3.34)	22.78 (18.64)	19.89 (9.81)	F = .69	.516	
Ever breastfed	67.1%	57.1%	88.9%	69.6%	χ^2 = 7.19	.027	
Hormonal contraception use	33.8%	42.2%	15.4%	32.6%	χ^2 = 12.60	.002	
Steroid medication use	.7%	1.4%	0%	0%			

Note. Unless displayed with a % symbol, values refer to means, and standard deviations are in parentheses. White = non-Hispanic White. a = Black; b = Latina; c = White.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Results of hierarchical regression analyses for these outcomes are reported in Table 5. Weight-related everyday discrimination was not significantly associated with either parameter of blood pressure (systolic and diastolic), or any of the three cortisol variables (awakening response, slope, and total daily output) at any time point.

False Discovery Rate Analysis

For each set of tests, a false discovery rate analysis (Benjamini & Hochberg, 1995) was conducted to account for alpha accumulation across multiple tests. In summary, p values for all previously significant findings neared or surpassed the corrected thresholds as shown in Table 6.

Discussion

This is among the first studies to prospectively examine adverse psychological and physical health outcomes associated with experiencing weight stigma during pregnancy among postpartum women. A number of specific hypotheses corresponding to mul-

Table 3
Hierarchical Regression Analyses for Variables Predicting Outcomes in Hypothesis 1

Variable	Model 1			Model 2		
	B	*SE B*	β	*B*	*SE B*	β
1 month postpartum depressive symptoms ($N = 206$)						
Race/ethnicity						
Black vs. White	1.14	.82	.13	.90	.82	.10
Latina vs. White	.56	.94	.05	.57	.93	.06
Multiple attributions	−.23	.83	−.02	−.28	.82	−.02
Age	.04	.06	.05	.05	.06	.06
Everyday discrimination				.12**	.04**	.19**
R^2		.01			.05	
ΔR^2					.04**	
Power					.42	
6 months postpartum depressive symptoms ($N = 137$)						
Race/ethnicity						
Black vs. White	1.77*	.88*	.21*	1.80*	.89*	.21*
Latina vs. White	1.21	1.08	.11	1.22	1.08	.11
Multiple attributions	1.10	.97	.10	1.17	.98	.10
Age	.04	.07	.06	.04	.07	.10
Previous PPD	.29***	.08***	.29***	.31***	.09***	.30***
Everyday discrimination				−.05	.06	−.07
R^2		.12			.13	
ΔR^2					.01	
Power					1.00	
1 year postpartum depressive symptoms ($N = 123$)						
Race/ethnicity						
Black vs. White	.07	.87	.01	−.01	.86	−.001
Latina vs. White	1.78	1.07	.16	1.75	1.06	.15
Multiple attributions	1.47	.90	.13	1.39	.89	.12
Age	.13†	.07†	.18†	.13*	.07*	.18*
Previous PPD	.48***	.08***	.46***	.46***	.08***	.46***
Everyday discrimination				.11*	.05*	.16*
R^2		.29			.31	
ΔR^2					.02*	
Power					1.00	

Note. PPD = postpartum depressive symptoms; White = non-Hispanic White.
† $p < .10$. * $p < .05$. *** $p < .001$.

tiple outcomes were tested in a diverse sample of over 200 postpartum women. Findings revealed that experiences of discrimination in everyday life that were attributed to weight were associated, at least in part, with greater weight gain and increased risk of excess weight gain over pregnancy, and with more depressive symptoms at 1 month postpartum. Weight discrimination also predicted greater postpartum weight retention and more depressive symptoms at 1 year postpartum. Given that postpartum depression and excess gestational weight are both associated with adverse downstream maternal and family health outcomes, these results are concerning. However, these retrospective maternal reports of weight-related discrimination experienced in pregnancy did not predict physiological measures of blood pressure or cortisol over the postpartum period.

In terms of the significant associations observed, the findings do not appear to be driven merely by objective BMI. Despite evidence suggesting that overweight and obesity are associated with both depressive symptomatology (Luppino et al., 2010) and weight gain in pregnancy (Deputy et al., 2015), in this sample, prepregnancy BMI was not related to everyday discrimination scores or any outcomes of interest. Moreover, these results were consistent even when controlling for prepregnancy BMI with one exception: for weight retention at 1 year postpartum, the relationship became marginally statistically significant. Therefore, it is likely not the case here that BMI was a third variable driving both the experience of weight stigma and the observed patterns of depressive symptomatology, gestational weight gain, and postpartum weight retention. This is not entirely surprising, considering that weight stigma can affect any individual who merely perceives him- or herself to be heavy (Himmelstein et al., 2015; Incollingo Rodriguez et al., 2016; Major et al., 2018). Accordingly, future research might consider the role that women's perception of their weight could play in the relationships reported here.

Interestingly, while weight-related discrimination predicted postpartum depressive symptoms and weight retention at 1 year postpartum, it did not predict these outcomes at 6 months postpartum. Although it is unclear as to why this pattern of findings emerged for the first two hypotheses, it may relate to the first year postpartum being a time of considerable physical and emotional changes for the mother. Perhaps, at 6 months postpartum, depressive symptoms and weight retention were still fluctuating too much for any potential influence of weight-related discrimination to emerge. This is consistent with typical patterns of postpartum mood and weight changes, which are high at this point (e.g., Chaudron et al., 2001; Rooney & Schauberger, 2002). By the 1-year postpartum assessment, however, the mothers' physical and

Table 4
Hierarchical Regression Analyses for Variables Predicting Outcomes in Hypothesis 2

Variable	Model 1			Model 2		
	B	*SE B*	β	*B*	*SE B*	β
Gestational weight gain ($N = 146$)						
Race/ethnicity						
Black vs. White	2.49	3.70	.07	.87	3.71	.03
Latina vs. White	−2.13	3.99	−.06	−2.55	3.93	−.07
Multiple attributions	6.85†	3.72†	.15†	6.77†	3.66†	.15†
Age	−.55†	.28†	−.18†	−.52†	.28†	−.17†
Primiparity	−7.23*	2.85*	−.21*	−7.16†	2.80†	−.21†
Everyday discrimination				.42*	.18*	.19*
R^2		.12			.15	
ΔR^2					.03*	
Power					.97	
Excess gestational weight gain ($N = 145$)						
Race/ethnicity						
Black vs. White	2.70	3.93	.08	.83	3.91	.02
Latina vs. White	−2.44	4.23	−.06	−2.96	4.14	−.08
Multiple attributions	4.83	4.01	.10	4.42	3.93	.09
Age	−.44	.30	−.14	−.41	.30	−.13
Primiparity	−6.32*	3.02*	−.18*	−6.15*	2.96*	−.18*
Everyday discrimination				.51**	.19**	.22**
R^2		.08			.13	
ΔR^2					.04**	
Power					.85	
6 months postpartum weight retention ($N = 81$)						
Race/ethnicity						
Black vs. White	4.08	5.69	.10	2.96	5.81	.07
Latina vs. White	−2.65	6.75	−.06	−3.30	6.79	−.07
Multiple attributions	7.88	6.82	.13	6.99	6.89	.12
Age	−.75†	.44†	−.23†	−.72	.44	−.22
Primiparity	−4.09	4.74	−.10	−4.00	4.74	−.10
Everyday discrimination				.33	.34	.11
R^2		.09			.10	
ΔR^2					.01	
Power					.90	
1 year postpartum weight retention ($N = 93$)						
Race/ethnicity						
Black vs. White	4.79	5.12	.12	1.86	5.29	.05
Latina vs. White	6.18	5.88	.14	5.03	5.79	.11
Multiple attributions	9.05	5.53	.17	8.91	5.43	.17
Age	−.56	.41	−.17	−.59	.40	−.18
Primiparity	−5.06	4.16	−.13	−5.10	4.09	−.13
Everyday discrimination				.59*	.28*	.21*
R^2		.11			.15	
ΔR^2					.04*	
Power					.86	

Note. White = non-Hispanic White.
† $p < .10$. * $p < .05$. ** $p < .01$.

psychological states may have been a more stable and valid indicator of postpartum health, allowing for this potential long-term relationship to be revealed. Still, considering the gap in time between the measurement of weight-related everyday discrimination and the 1-year postpartum measures, more proximal measures would be ideal. Future research can verify this pattern of results, particularly through obtaining measures of weight stigma throughout the postpartum period to analyze both immediate and long-term influences.

Although the broader weight stigma literature demonstrates that weight stigma affects blood pressure and cortisol, these outcomes were not associated with weight-related everyday discrimination in this study. This prior literature, however, comes from experimental paradigms where blood pressure and cortisol reactivity were measured immediately after a stigmatizing experience (e.g., Himmelstein et al., 2015; Major et al., 2012; Schvey et al., 2014). Thus, considering the null results here for blood pressure and cortisol parameters, it is possible that the single self-report assessment of weight stigma was simply not sensitive enough to predict these single time point physiological measures over time. Future research could expand upon the analyses conducted here by measuring daily experiences of weight stigma and daily blood pressure and cortisol during selected weeks of pregnancy and postpartum. This would allow for a test of whether weight stigma may have a more proximal effect on reactivity in these relevant health markers.

Table 5
Hierarchical Regression Analyses for Variables Predicting Outcomes in Hypothesis 3

Variable	Model 1			Model 2		
	B	*SE B*	β	*B*	*SE B*	β
6 months systolic blood pressure ($N = 118$)						
Race/ethnicity						
Black vs. White	11.44***	2.93***	.42***	11.67***	2.97***	.43***
Latina vs. White	4.87	3.70	.15	5.00	3.72	.15
Multiple attributions	−4.28	3.16	−.12	−4.09	3.19	−.11
Age	.90***	.24***	.40***	.89***	.24***	.40***
Education	.65	.51	.14	.67	.52	.14
C-section	1.00	2.30	.04	.85	2.32	.03
Everyday discrimination				−.11	.18	−.05
R^2		.23			.23	
ΔR^2					.002	
Power					1.00	
6 months diastolic blood pressure ($N = 118$)						
Race/ethnicity						
Black vs. White	8.86**	2.60**	.37**	8.68**	2.63**	.36**
Latina vs. White	2.00	3.28	.07	1.90	3.30	.07
Multiple attributions	−4.97†	2.80†	−.15†	−5.12†	2.82†	−.16†
Age	.83***	.22***	.41***	.83***	.22***	.41***
Education	.25	.46	.06	.23	.46	.06
C-section	1.85	2.04	.08	1.97	2.06	.08
Everyday discrimination				.09	.16	.05
R^2		.23			.23	
ΔR^2					.002	
Power					1.00	
1 year systolic blood pressure ($N = 132$)						
Race/ethnicity						
Black vs. White	5.28†	2.99†	.21†	5.65†	3.04†	.22†
Latina vs. White	1.35	3.72	.04	1.37	3.73	.04
Multiple attributions	.34	3.05	.01	.39	3.06	.01
Age	.58*	.23*	.26*	.59*	.23*	.27*
Education	.20	.50	.05	.17	.50	.04
C-section	.17	2.26	.01	.29	2.27	.01
Everyday discrimination				−.13	.17	−.07
R^2		.08			.08	
ΔR^2					.004	
Power					.97	
1 year diastolic blood pressure ($N = 132$)						
Race/ethnicity						
Black vs. White	4.66*	2.31*	.23*	4.71*	2.35*	.23*
Latina vs. White	.34	2.88	.01	.35	2.89	.01
Multiple attributions	−2.48	2.36	−.09	−2.47	2.37	−.09
Age	.41*	.18*	.24*	.42*	.18*	.24*
Education	.25	.39	.07	.24	.39	.07
C-section	3.89*	1.75*	.19*	3.91*	1.76*	.19*
Everyday discrimination				−.02	.13	−.01
R^2		.13			.13	
ΔR^2					.00	
Power					1.00	
6 months total daily cortisol ($N = 71$)						
Race/ethnicity						
Black vs. White	−.55	.89	−.10	−.54	.90	−.10
Latina vs. White	−1.70	1.03	−.27	−1.69	1.04	−.27
Multiple attributions	−.02	.98	.00	.00	.99	.00
Age	−.02	.07	−.05	−.02	.07	−.05
Education	−.10	.13	−.12	−.10	.13	−.12
C-section	.57	.70	.11	.54	.72	.10
Everyday discrimination				−.01	.05	−.02
R^2		.06			.06	
ΔR^2					.00	
Power					.96	
6 months cortisol awakening response ($N = 71$)						
Race/ethnicity						
Black vs. White	−.11	.11	−.15	−.10	.11	−.14

(*table continues*)

Table 5 (*continued*)

Variable	Model 1			Model 2		
	B	*SE B*	β	*B*	*SE B*	β
Latina vs. White	−.05	.13	−.06	−.04	.13	−.05
Multiple attributions	−.19	.13	−.18	−.19	.14	−.18
Age	.01	.01	.13	.01	.01	.13
Education	−.02	.02	−.18	−.02	.02	−.17
C-section	.17	.09	.26	.16	.09	.25
Everyday discrimination				.00	.01	−.07
R^2		.13			.13	
ΔR^2					.005	
Power					.98	
6 months cortisol slope (N = 71)						
Race/ethnicity						
Black vs. White	.01	.01	.10	.01	.01	.11
Latina vs. White	.00	.01	.06	.00	.01	.06
Multiple attributions	−.02*	.01*	−.32*	−.02*	.01*	−.31*
Age	.00	.00	−.10	.00	.00	−.09
Education	.00	.00	.00	.00	.00	.01
C-section	.01	.01	.19	.01	.01	.16
Everyday discrimination				.00	.00	−.14
R^2		.14			.16	
ΔR^2					.02	
Power					.95	
1 year total daily cortisol (N = 70)						
Race/ethnicity						
Black vs. White	−2.18†	1.10†	−.30†	−1.84	1.11	−.25
Latina vs. White	−2.14	1.33	−.25	−2.16	1.31	−.25
Multiple attributions	.29	1.23	.03	.44	1.22	.05
Age	.03	.09	.04	.04	.09	.07
Education	−.04	.18	−.03	−.08	.18	−.06
C-section	.94	.88	.13	.94	.86	.13
Everyday discrimination				−.12	.07	−.20
R^2		.12			.16	
ΔR^2					.04	
Power					.85	
1 year cortisol awakening response (N = 56)						
Race/ethnicity						
Black vs. White	−.23*	.10*	−.39*	−.22*	.10*	−.37*
Latina vs. White	−.12	.12	−.19	−.13	.12	−.19
Multiple attributions	.02	.12	.02	.03	.12	.03
Age	.00	.01	−.05	.00	.01	−.04
Education	.00	.02	.01	.00	.02	.01
C-section	−.02	.08	−.03	−.02	.08	−.03
Everyday discrimination				.00	.01	−.05
R^2		.11			.11	
ΔR^2					.002	
Power					.97	
1 year cortisol slope (N = 72)						
Race/ethnicity						
Black vs. White	.00	.01	.05	.00	.01	.04
Latina vs. White	.00	.01	.08	.00	.01	.08
Multiple attributions	−.01	.01	−.11	−.01	.01	−.12
Age	.00	.00	.08	.00	.00	.08
Education	.00	.00	−.15	.00	.00	−.14
C-section	.00	.01	−.01	.00	.01	−.01
Everyday discrimination				.00	.00	.05
R^2		.04			.04	
ΔR^2					.002	
Power					.88	

Note. White = Non-Hispanic White.
† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 6
False Discovery Rate Analyses for Each Hypothesis

Rank of *p* value	Outcome	Original *p* value	Corrected threshold
Hypothesis 1			
1	One-month postpartum depressive symptoms	.008	.017
2	One-year postpartum depressive symptoms	.049	.033
3	Six months postpartum depressive symptoms	.400	.050
Hypothesis 2			
1	Excess gestational weight gain	.009	.013
2	Gestational weight gain	.020	.025
3	One-year weight retention	.041	.038
4	Six months weight retention	.339	.050
Hypothesis 3			
1	One-year total daily cortisol	.112	.005
2	Six months cortisol slope	.255	.010
3	One-year systolic blood pressure	.455	.015
4	Six months systolic blood pressure	.556	.020
5	Six months cortisol awakening response	.580	.025
6	Six months diastolic blood pressure	.600	.030
7	One-year cortisol slope	.723	.035
8	One-year cortisol awakening response	.755	.040
9	Six months total daily cortisol	.856	.045
10	One-year diastolic blood pressure	.881	.050

Note. For this false discovery rate analysis, outcomes from each hypothesis are listed in rank order of their *p* values. Each rank is multiplied by .05 and divided by the number of variables in the analyses to produce a corrected threshold for determining significance (Benjamini & Hochberg, 1995).

In terms of limitations, this study had a relatively small sample size, although it was nonetheless low income and diverse in terms of race/ethnicity. Additionally, participants' attribution for their experiences of everyday discrimination was, in fact, height or weight, not weight alone. Height, though, was not related to everyday discrimination scores nor did it influence results when accounted for in analyses. Moreover, using the Everyday Discrimination Scale in this manner to assess weight-related discrimination is a standard approach for addressing this nuance in the weight stigma literature (e.g., Andreyeva, Puhl, & Brownell, 2008). Finally, while findings are consistent with the broader weight stigma literature indicating that experiencing weight stigma promotes depressive symptomatology (Papadopoulos & Brennan, 2015) and even weight gain itself (Jackson et al., 2014), the retrospective report of everyday discrimination presents limitations. Namely, the direction of causality of associations of everyday discrimination and outcomes measured at 1 month postpartum is ambiguous, given concurrent measurement. It is possible that weight gain precipitated the weight-related discrimination. However, the nature of the Everyday Discrimination Scale stem asks for a retrospective report over the previous year, meaning that the experiences ostensibly occurred within the timeframe of the pregnancy (although perhaps also in the month or two before pregnancy) and not contemporaneously with the outcomes. Nonetheless, future research should continue to investigate these relationships prospectively through obtaining detailed diary measures of experiences of weight stigma during pregnancy, which would improve upon scales such as that used here.

In conclusion, the original study from which these data were drawn did not have an a priori focus on weight stigma, but the dataset provided a unique opportunity to investigate potential adverse effects of weight stigma experienced in the context of pregnancy in a diverse community sample. The results reported here suggest that, indeed, experiencing weight stigma during pregnancy is associated with deleterious outcomes and that weight stigma in pregnancy may be problematic for low-SES women from a variety of racial and ethnic backgrounds. These results contribute to the current scientific understanding of how social factors may affect maternal health over the postpartum period, which has implications for health care contexts, where weight stigma is particularly prevalent (Puhl & Heuer, 2009) and may be increasing (Tomiyama et al., 2015). As pregnant women must make frequent visits to their health care provider, it is important to consider whether stigmatizing interactions in health care settings could potentially put them at risk for long-term adverse effects. These findings also have implications for communities in general, which might seek to raise awareness of the potential dangers of pregnancy-related weight stigma at the community level so as to create healthier environments for expecting and new mothers. Finally, this work sets the stage for future prospective longitudinal investigations using more detailed and frequent assessments of both weight-related discrimination and important maternal physical and mental health outcomes. This new direction of research can contribute to the understanding of the consequences of weight stigma and potentially also to maternal-child health and health care policy.

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