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Research Article

Associations between Stress, Body Mass Index, Demographics and Eating Behaviors in Low-Income Overweight or Obese Women

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Abstract

Purpose: This study investigated the associations between stress, body mass index (BMI) category (overweight versus obesity), pregnancy status (pregnant versus postpartum) and distinct domains of eating behaviors (restrained eating, overeating, or uncontrolled eating) in low-income women. This study also examined whether BMI category or pregnancy status moderated the associations between stress and eating behaviors.

Methods: 688 low-income women completed previously validated surveys measuring stress and eating behaviors. Linear regression analysis was performed.

Results: Stress was not significantly associated with restrained eating. However, stress was significantly associated with overeating (unstandardized parameter estimate (B=0.10, p<0.0001, 95% CI: 0.08, 0.12) and with uncontrolled eating (B=0.11, p<0.0001; 95% CI: 0.08, 0.14). BMI category and pregnancy status were not associated with any types of eating behaviors and did not affect the associations between stress and restrained eating, overeating or uncontrolled eating.

Conclusion: The presence of significant associations between stress and overeating and between stress and uncontrolled eating support the possibility that enhanced ability to manage or cope with stress might have associated influences on ability to manage weight regardless low-income women's body size or pregnancy status.

Keywords: Eating behavior; Obesity; Stress; Low-income women; Body weight

Introduction

Poverty contributes to obesity disparities in American adults: 45.2% low-income *vs.* 29.7% higher income [1]. Compared to normal weight women, overweight or obese women are at least twice as likely to experience excessive gestational weight gain (34% for normal weight *vs.* 65-85% for overweight or obese) [2-5], which is associated with adverse maternal and birth outcomes (e.g., gestational diabetes, gestational hypertension, macrosomia) [6,7]. Compared to higher-income women, lower-income women are at least twice the risk for significant weight retention at 1-year postpartum (retain ≥4.5 kg; 68-75% lower-income *vs.* 32% higher-income [2] -- a strong predictor for life-long obesity [8]. Obesity is strongly associated with key cardiovascular risk factors such as type 2 diabetes and hypertension [9], all of which can be delayed or reduced via weight loss [10]. Taken together, these statistics point to a need for effective weight management programming for low-income overweight or obese pregnant and postpartum women. Yet, few weight management intervention studies exist for this priority population [11,12].

Recent attempts to combat obesity propose that stress is a fundamental link between low income and weight gain [13]. Psychological stress, hereafter stress, is highly prevalent [14-17], associated with cardiovascular disease [18], and reliably linked with obesity in low-income women of child-bearing age [19-21]. Stress is constructed from an appraisal of the balance between perceived resources (or perceived personal vulnerability defined as appraisal of available resources to cope with stress) and perceived demands (or event load defined as appraisal of life events, such as moving, divorce, death of spouse, or assault) [22]. High levels of stress occur when individuals experience high personal vulnerability (depletion of resources) and high event load [22].

High levels of stress trigger a cascade of behaviors that contribute to weight gain, such as eating to suppress psychological distress [13]. To date, only a few studies have investigated the associations between stress and distinct domains of eating behaviors [23-25], such as restrained eating (defined as conscious efforts to limit calories and food intake in order to control body weight), overeating (defined as a tendency to overeat in the presence of emotional stress or palatable foods), and uncontrolled eating (defined as a tendency to overeat, without feeling of being in control). Prior studies have shown no association between stress and restrained eating in female college students [24] or low-income women of child-bearing age [25]. However, stress was associated with overeating and uncontrolled eating in non-low-income child-bearing aged women [23].

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The potential role of stress in eating behaviors may constitute an important issue for research testing weight management interventions that include stress management. A crucial step in determining whether weight management interventions for low-income overweight or obese women should include stress management is to test whether stress is associated with eating behaviors related to weight management for these women [26]. We examined associations between stress and distinct domains of eating behaviors in the current study. Spanning weight management interventions from pregnancy to postpartum is also potentially critical for low-income overweight and obese women to promote maternal health outcomes. However, whether stress might play a similar role in eating for pregnant versus postpartum low-income women remains unknown. Therefore, this study investigated the associations between stress, BMI category (overweight versus obesity), pregnancy status (pregnant versus postpartum) and distinct domains of eating behaviors (restrained eating, overeating, or uncontrolled eating) in low-income women. It was hypothesized that there were associations among these variables. This study also examined whether BMI category or pregnancy status moderated the association between stress and eating behaviors. It was hypothesized that women with obesity were likely report lower levels of restrained eating but higher levels of overeating and uncontrolled eating, and postpartum women were likely to report higher levels of restrained eating and lower levels of overeating and uncontrolled eating. The hypotheses were specified prior to data collection.

Methods

Design, setting, sample and procedures

We conducted a cross-sectional study and recruited participants from a prenatal care clinic affiliated with a university hospital serving predominantly low-income women. We also recruited participants from the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) in Ohio. WIC is one of the largest federally funded nutrition programs in the U.S. and serves low-income pregnant, postpartum and breastfeeding women and children (0-5 years). The trained recruiters personally invited women to participate in the study while they waited for their prenatal care or WIC appointments. To qualify for WIC, women must have an annual household income at or below 185% of the federal poverty line. Trained recruiters personally invited women waiting for appointments to participate in the study. Eligible women were pregnant or within 1-year postpartum, ≥18 years old, able to read and speak English, received government assistant programs (such as WIC and Medicaid), and had a self-reported BMI ≥ 25.0kg/m^2 (pre-pregnancy weight for pregnant women and current weight for postpartum women). Recruits signed a written consent form prior to participation followed by completing a self-administered pencil-and paper survey. The Ohio State University and Ohio Department of Health Institute Review Boards for Human Subject approved the study procedure.

Measures

Independent variable:

Stress: We used the Short Stress Overload Scale (10 items) that was developed and tested in a U.S. representative sample. The survey has established construct validity, concurrent (r = 0.81), and predictive validity (r = 0.45). The survey has shown good reliability (test-retest r = 0.75, Cronbach alpha [α] = 0.94) [27]. Participants used a 5-point response scale (1 = not at all to 5 = a lot) to respond to questions related to personal vulnerability (5 items) and event load (5 items). On the personal vulnerability items, participants self-reported their feelings of (e.g.,) odds against them in the past 7 days [27]. On the event load items, participants self-reported their feelings of (e.g.,) being swamped by responsibility in the past 7 days [27]. We summed the 10-item scores (range = 10-50), with a higher score indicating higher levels of stress.

Outcome variables:

Eating Behaviors: Restrained eating, overeating, and uncontrolled eating. We used the Three-Factor Eating Questionnaire (TFEQ, 51 items) [28] to measure eating behaviors. The questionnaire has demonstrated construct validity and includes 3 distinct domains of eating behavior: restrained eating (21 items), overeating (16 items), and uncontrolled eating (14 items). Participants used a 2-point response scale (0 = false, 1 = true) to respond to questions. For example, "I deliberately take small helpings as a means of controlling my weight" (restrained eating); "I usually eat too much at social occasions, like parties and picnics" (overeating); I am always hungry enough to eat at any time" (uncontrolled eating). We summed the 21-item restrained eating scores, with higher scores indicating higher levels of retrained eating. We also summed the 16 items of overeating subscale and 14 items of uncontrolled eating subscale, the higher scores indicating higher levels of overeating or uncontrolled eating, respectively.

Weight status BMI (kg/m^2)

We used self-reported height and weight to calculate BMI. We grouped women into overweight (BMI ≥25.0-29.9 kg/m^2) or obese (BMI ≥30.0kg/m^2) categories.

Pregnancy status

We used self-reported pregnancy status. Women reported gestational age in weeks and postpartum status in weeks and months. We grouped women into pregnancy or postpartum group regardless of their gestational ages and postpartum period.

Statistical analysis

In the analysis, we included 688 women (pregnant women = 337 and postpartum women = 351) after excluding 19 women (2.76%) who did not completed the survey, because children needed attention or women's rides arrived. There were no statistically significant differences by race/ethnicity, educational attainment, BMI between those who were included and excluded in the analysis. The remaining data set had <0.01% missing data and we used hot deck imputation technique to impute missing data [29]. The primary analyses were linear regressions treating restrained eating, overeating, and uncontrolled eating as the respective outcome variables and using the stress composite, BMI category (0 = overweight, 1 = obesity), and pregnancy status (0 = pregnant, 1 = postpartum) as the primary independent variables in a first model. In follow-up models, we examined whether BMI category or pregnancy status moderated the associations between stress and the eating behavior variables. In all analyses, covariates included age, race/ethnicity, and educational attainment [1], all of which are associated with body weight. We treated age as a continuous variable. We dichotomized race as Non-

Table 1: Demographics of the study participants and mean score of study variables (N=688)*.

	Pregnant Women (N=337)		Postpartum Women (N=351)	
	Overweight (n=86)	Obese (n=251)	Overweight (n=110)	Obese (n=241)
	n (%)	**n (%)**	**n (%)**	**n (%)**
Ethnic/Racial Minority	47 (54.65)	167 (66.53)	58 (52.73)	120 (49.79)
≥ some college education	38 (44.19)	114 (45.42)	58 (52.73)	131 (54.36)
	Mean (SD)	**Mean (SD)**	**Mean (SD)**	**Mean (SD)**
Age (years)	26.91 (5.73)	27.71 (5.69)	26.58 (5.37)	27.55 (5.35)
Body mass index (kg/m^2)	27.59 (1.57)	38.7 (6.89)	27.59 (1.63)	37.02 (6.14)
Stress	22.40 (9.06)	22.65 (9.80)	22.25 (10.81)	22.91 (10.40)
Restrained eating	6.30 (4.20)	6.49 (3.91)	6.95 (4.78)	7.68 (4.62)
Overeating	5.03 (2.84)	4.69 (2.89)	4.42 (3.09)	5.21 (3.27)
Uncontrolled eating	5.09 (3.54)	4.77 (3.50)	4.31 (3.22)	4.66 (3.58)

*Pregnant women reported body weight prior to becoming pregnant. Postpartum women reported current body weight. Ethnic/racial minority includes non-Hispanic Black Asian American or Asian, Native Hawaiian or Pacific Islander, American Indian or Alaska Native and Hispanic. Stress (range=10-50): higher scores indicate higher levels of stress. Restrained eating (range=0-21): higher scores indicate higher levels of restrained eating. Overeating (range=0-16): higher scores indicate high levels of overeating. Uncontrolled eating (range=0-14): higher scores indicate high levels of overeating or eating in the absence of hunger.

Table 2: Unstandardized Regression coefficients, p values, and confidence intervals for independent variables of restrained eating, overeating, and uncontrolled eating (N = 668).

	Main Effect Only Model					
	Outcome Variables					
	Restrained Eating		Overeating		Uncontrolled Eating	
Predictors	**B (SE)**	**95% CI**	**B (SE)**	**95% CI**	**B (SE)**	**95% CI**
Stress	0.02 (0.02)	-0.01; 0.06	**0.10 (0.01)*** **	0.08; 0.12	**0.11 (0.01)*** **	0.08; 0.14
Obesity	0.40 (0.37)	-0.32; 1.11	0.24 (0.24)	-0.24; 0.72	0.02 (0.28)	-0.53; 0.57
Pregnancy status	0.94 (0.33)**	0.29; 1.59	0.10 (0.22)	-0.33; 0.54	-0.32 (0.26)	-0.82; 0.19
Age	0.09 (0.03)**	0.02; 0.15	-0.00 (0.02)	-0.04; 0.04	-0.04 (0.02)	-0.08; 0.01
Educational Attainment	0.61 (0.35)	-0.07; 1.29	0.30 (0.23)	-0.16; 0.75	-0.04 (0.27)	-0.57; 0.49
Race	-0.46 (0.34)	-1.12; 0.20	-0.42 (0.22)	-0.86; 0.02	0.00 (0.26)	-0.51;0.51
Stress x BMI category	-0.05 (0.04)	-0.12; 0.02	0.01 0.02	-.04; 0.06	0.02 (0.03)	-0.04; 0.07
Stress x Pregnancy status	0.06 (0.03)	-0.01; 0.12	0.03 (0.02)	-0.02; 0.07	0.03 (0.03)	-0.02; 0.08

B: Unstandardized parameter estimate. *p <0.05; **p <0.01; ***p <0.001.
BMI category (0 = Overweight, 1 = Obesity), pregnancy status (0 = Pregnant, 1 = Postpartum), age as a continuous variable, education (0 = ≤ high school, 1 = at least some college education).

Hispanic (NH) White (coded as 0) vs. other racial/ethnic minority (coded as 1, NH Black, NH Asian Americans or Asian, NH Native Hawaiian or Pacific Islander, NH American Indian or Alaska and Hispanic). We also dichotomized educational attainment as high school or less education (coded as 0) versus at least some college education (coded as 1). SAS version 9.4 (Carry, NC, USA: SAS Institute Inc) were used to perform all analyses.

Results

Table 1 presents demographics of the study participants and mean score of study variables by BMI category and pregnancy status. Table 2 summarizes results of linear regression analysis.

Demographics

For the 337 pregnant women who provided complete data, the mean age was 27.50 (SD = 5.7) years old; 63.5% were minorities; 54.9% had a high school or less education. For the 351 postpartum women who provided complete data, the mean age was 27.3 (SD = 5.4) years old; 50.7% were minorities; 46.2% had a high school or less education.

Associations between stress, BMI category, pregnancy status and 3 eating behaviors

Restrained eating: Stress was not significantly associated with restrained eating, though pregnancy status (unstandardized parameter estimate (B = 0.94, p <0.01, 95% CI = 0.29, 1.59) and age (B = 0.09, p <0.01, 95% CI = 0.02, 0.15) each were significantly associated with restrained eating. BMI category was not associated with restrained eating.

Overeating: Stress was significantly associated with overeating (B=0.10, p <0.001, 95% CI = 0.08-0.12). None of the other independent variables were significantly associated with overeating.

Uncontrolled eating: Stress was significantly associated with uncontrolled eating (B=0.11, p <0.001, 95% CI = 0.08, 0.14). None of the other independent variables were significantly associated with

overeating.

Moderation effects

In a follow-up model, we included the terms representing interactions of stress and BMI category and interaction of stress and pregnancy status. There was neither interaction reached significance in any of 3 eating behaviors.

Discussion

Low-income and high levels of stress play important roles in health disparities [1,30], such as those found with obesity. Low-income overweight or obese women live stressful daily life and are at high risk of pregnancy and obesity related chronic conditions [6,7,9]. These conditions are preventable or can be delayed *via* healthy eating [31], which is associated with distinct dimensions of eating behaviors [32]. The present study goes beyond prior research by examining the associations between stress, BMI category, pregnancy status, and 3 eating behaviors in low-income women. The current research also filled in a key knowledge gap by examining whether any associations between stress and eating behaviors might vary between participants who were overweight versus obese or who were pregnant versus postpartum.

We did not observe an association between stress and restrained eating, which did not support our hypotheses. This finding is consistent with prior studies of child-bearing aged women [24,25], but is inconsistent with a prior study of middle-aged women [33]. Previous research has shown that obese adults were more likely to engage in restrained eating than normal weight adults in order to manage weight [34]. Yet, we detected no difference in reporting restrained eating in low-income women regardless of their BMI status. The inconsistent finding might have been related to the use of a different comparison group (normal weight versus overweight). We found that postpartum women were more likely to report restrained eating than pregnant women. It is possible that low-income overweight or obese pregnant women were encouraged by their family members to eat more for the health of the fetus even when they tried to cut down their food intake to control pregnancy weight gain [35]. On the other hand, postpartum women might have been motivated to lose weight gained during pregnancy by making conscious efforts to limit calories and food intake.

Overeating is associated with weight gain and obesity [36,37]. Many prior studies have used the term emotional eating instead of overeating, a tendency to overeat in the presence of emotional stress or palatable foods, to report their findings. Thus, the discussion will include literature in both areas. Consistent with prior research [23,25], we found that low-income overweight or obese pregnant or postpartum with higher levels of stress were more likely to report overeating or emotional eating than those with lower levels of stress, findings supported our first hypotheses. This is a great concern because emotional eating and higher levels of stress have been associated with binge eating disorder [38] and unhealthy eating [39]. Our findings suggest the importance of including stress management components to intervention studies aimed to promote healthy eating in the priority populations. We found that low-income women reported similar overeating behaviors across regardless of their body size. Such finding might have been related to tendencies for overeating in overweight or obese women of child-bearing age [40,41]. Similarly, we did not find any difference of reported overeating between pregnant and postpartum women. It is possible that low-income overweight or obese women tried to avoid overeating in order to manage their weight, regardless of their pregnancy status.

We found that women who reported higher levels of stress were more likely to report uncontrolled eating than those who reported lower levels of stress, which supports the hypotheses and is consistent with prior research [23,25,33,42]. Our findings of uncontrolled eating have similar patterns as overeating described above. Uncontrolled eating has been associated with higher caloric intake [32]. Also, uncontrolled eating during pregnancy predicts faster fetus growth, a risk of macrosomia (large baby for the gestational age) [43]. Prior research has reported the link between uncontrolled eating and obesity in low-income postpartum women with all body sizes [25], which is contradictory to our finding.

Hypothesis 2

Our findings did not support our hypotheses 2: BMI category or pregnancy status did not influence the association between stress and restrained eating, overeating, and uncontrolled eating. These non-significant findings might have been related to the stressful experience of the pregnancy and postpartum periods, adding another layer of stress on low-income women, who already experience daily stress [14,39].

Strengths and Limitations

Strengths of the study include a sizeable sample drawing on an underserved and medically vulnerable population for which little research exists, contributing valuable data to help inform future research policy and practice. This study used a comprehensive measure of distinct domains of eating behaviors to more narrowly define the complex relationships between stress and problematic eating behaviors. Limitations of this study include the cross-sectional design precluding any causal inferences. We recruited most of the pregnant women from a prenatal care clinic that serves low-income pregnant women at high risk for adverse maternal and birth outcomes (e.g., gestational diabetes, history of premature birth, and drug and alcohol abuse) which could contribute to sampling bias. Also, we included pregnant women at any gestational age and women within 1-year postpartum. Therefore, results of this study might not be generalizable to overweight or obese women with healthier pregnancies or to women beyond 1-year postpartum. Also, we used self-reported height and weight to calculate BMI, so those measures might not be as precise as when they are measured more objective.

Conclusions-Need to Figure Out Where to Go

The current findings show that higher levels of stress are positively associated with problematic eating behaviors of overeating (emotional eating) and uncontrolled eating in low-income overweight or obese pregnant or postpartum women. Our findings also suggest that these associations are the same regardless of overweight or obese BMI status as well as for pregnant versus postpartum women. Weight control interventions, recommendations and practices for low-income overweight or obese pregnant or postpartum women should include measurement and management of stress to successfully manage weight to help reduce risks associated with pregnancy and

motherhood.

Declaration

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Author contributions: Conceptualization: Mei-Wei Chang, Duane T. Wegener, Rebecca E. Lee. Methodology: data collection and cleaning, and supervision: Mei-Wei Chang. Writing-original draft preparation: Mei-Wei Chang, Duane T. Wegener. Validation, statistical analysis: Jolynn Pek, Duane T. Wegener. Review and editing manuscript: Mei-Wei Chang, Duane T. Wegener, Jolynn Pek, Rebecca E. Lee.

Ethics approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the Ohio State University Human Subject Review Board.

Consent to participate: Informed consent was obtained from all individual participants included in the study.

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