# Prepregnancy Body Mass Index, Gestational Weight Gain, and Elevated Depressive Symptoms in a Hispanic Cohort

**Karen A. Ertel**,
University of Massachusetts

**Marushka L. Silveira**,
University of Massachusetts

**Penelope S. Pekow**,
University of Massachusetts

**Nancy Dole**,
University of North Carolina

**Glenn Markenson**, and
Baystate Medical Center, Springfield, Massachusetts

**Lisa Chasan-Taber**
University of Massachusetts

## Abstract

**Objectives**—Our objective was to assess the associations among prepregnancy Body Mass Index (BMI), gestational weight gain (GWG), and elevated depressive symptoms across pregnancy.

**Methods**—We evaluated these associations among 1,090 participants in Proyecto Buena Salud, a prospective cohort study of Hispanic (predominantly Puerto Rican) women in Western Massachusetts. BMI and GWG were self-reported; GWG was classified according to the 2009 Institute of Medicine guidelines. Depressive symptoms were assessed in early, mid-, and late pregnancy using the 10-item Edinburgh Postnatal Depression Scale (EPDS). We defined elevated depressive symptoms as EPDS scores 13 and 15.

**Results**—In multivariable, longitudinal modeling, overweight (25.0 to <30 kg/m$^2$) women had an odds ratio of 0.53 (95% CI [0.31, 0.90]) for EPDS scores 13 and 0.51 (95% CI [0.28, 0.91]) for EPDS scores 15 compared to normal weight women. We did not observe an association between GWG or an interaction between BMI and GWG, in predicting elevated depressive symptoms.

**Conclusions**—Our findings provide preliminary support for an association of prepregnancy overweight status and lower depressive symptoms across pregnancy in Hispanic women. Future

Correspondence concerning this article should be addressed to Karen A. Ertel, Division of Biostatistics and Epidemiology, School of Public Health and Health Sciences, 423 Arnold House, University of Massachusetts, 715 North Pleasant Street, Amherst, MA 01003-9304. kertel@schoolph.umass.edu.

Karen A. Ertel, Marushka L. Silveira, and Penelope S. Pekow, Division of Biostatistics and Epidemiology, Department of Public Health, School of Public Health and Health Sciences, University of Massachusetts; Nancy Dole, Carolina Population Center, University of North Carolina; Glenn Markenson, Baystate Medical Center, Springfield, Massachusetts; Lisa Chasan-Taber, Division of Biostatistics and Epidemiology, Department of Public Health, School of Public Health and Health Sciences, University of Massachusetts.

research should focus on potential social and cultural differences in perceptions of weight and weight gain in the perinatal period and how these influence psychological health.

Excess weight is an epidemic problem in the United States, with 69.2% of the adult population overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014). Prepregnancy obesity has been associated with increased risk of adverse pregnancy and birth outcomes including gestational hypertension, preeclampsia, and macrosomia, and, for the infant, increased risk of obesity later in life (Papachatzi, Dimitriou, Dimitropoulos, & Vantarakis, 2013; Patro et al., 2013; Sarwer, Allison, Gibbons, Markowitz, & Nelson, 2006). Gestational weight gain (GWG) guidelines are based on prepregnancy Body Mass Index (BMI), with overweight and obese women encouraged to gain less weight during pregnancy compared to normal and underweight women (Institute of Medicine and National Research Council, 2009). Hispanic mothers are more likely to begin their pregnancies overweight or obese compared to non-Hispanic White women (Kieffer et al., 2006).

While obesity predicts depression and elevated depressive symptoms in nonpregnant women (Luppino et al., 2010), studies in the perinatal period are sparse. However, prenatal depression is common: occurring in up to 18% of women in the United States (Gavin et al., 2005), and up to 33% of Hispanic women in the United States (Chasan-Taber et al., 2010). Given current societal pressure in the United States to be thin, overweight women and those who gain excess weight may experience high levels of body dissatisfaction, which has been linked to depression (Clark, Skouteris, Wertheim, Paxton, & Milgrom, 2009).

Our objective was to assess the association between prepregnancy BMI, GWG, and elevated depressive symptoms during pregnancy in a Hispanic cohort. We hypothesized that women who were overweight, obese, or gained more than the recommended amount of weight during pregnancy would experience elevated depressive symptoms during pregnancy.

## Method

Proyecto Buena Salud was conducted from 2006 to 2011 in the ambulatory obstetrical practices of a large tertiary care facility in Western Massachusetts. The overall goal was to examine the relationship between physical activity, psychosocial stress, and gestational diabetes in Hispanic women of predominantly Puerto Rican heritage (Chasan-Taber et al., 2010). The study was approved by the Institutional Review Boards of the University of Massachusetts-Amherst and Baystate Medical Center.

A total of 1,604 prenatal care patients were enrolled. For this analysis, we excluded 69 (4%) participants who experienced a miscarriage, 160 (10%) participants who did not deliver at Baystate Medical Center, and 75 (5%) participants missing weight gain information. From the remaining 1,300 participants, 1,234 women (95%) had information on depressive symptoms either during early, mid-, or late pregnancy. Among this group, information on

depressive symptoms was available for 832 (67%) in early pregnancy; 759 (62%) in midpregnancy; and 746 (60%) in late pregnancy. Participants with information on depressive symptoms did not differ from those missing this information with the exception of age and health insurance. Finally, we excluded women missing information on covariates for a final sample of 1,090.

### Prepregnancy BMI and Gestational Weight Gain

Prepregnancy weight was either self-reported to the interviewer at the time of recruitment (95.2%) or self-reported to the practitioner at the time of the first prenatal care visit and recorded in the medical record (4.3%). If prepregnancy weight was not available from either of these sources, it was based upon measured weight at the first prenatal care visit (0.5%). A recent validation study found a strong correlation (0.95, $p = .0001$) between self-reported prepregnancy weight and physician measured weight from the year before pregnancy with a mean discrepancy of $0.5 \pm 3.0$ kg and no significant ($p = .64$) differences between normal weight and overweight/obese subjects ($r = .95$) (Phelan et al., 2011). Prepregnancy BMI was categorized as underweight ($<18.5$ kg/m$^2$), normal weight (18.5 to $<25.0$ kg/m$^2$), overweight (25.0 to $<30$ kg/m$^2$), and obese ( 30.0 kg/m$^2$).

Height and weight at delivery were abstracted from the medical record. Total GWG was calculated by subtracting prepregnancy weight from the weight at delivery and classified as either within, below, or above the 2009 Institute of Medicine weight gain guidelines (Institute of Medicine and National Research Council, 2009): 28–40 pounds for underweight women, 25–35 pounds for normal weight women, 15–25 pounds for overweight women, and 11–20 pounds for obese women.

### Elevated Depressive Symptoms

Depressive symptoms were assessed in early ($M = 12.4$ weeks gestation; range 4.1–18 weeks), mid- ($M = 21.3$ weeks gestation; range 18–26 weeks), or late ($M = 30.8$ weeks; range 26.1–40.9 weeks) pregnancy by bilingual interviewers using the 10-item Edinburgh Postnatal Depression Scale (EPDS) available in English (Cox, Holden, & Sagovsky, 1987) and Spanish (Jadresic, Araya, & Jara, 1995). The EPDS is a screening tool that measures symptoms of depression, and is not a clinical diagnosis of depression. Compared to other depression screening scales, the EPDS has the advantage of relying less on physical symptoms (e.g., fatigue, sleep disturbances, appetite changes), which are typical of normal pregnancy, irrespective of mood states, and therefore avoids overestimates of depression prevalence (Nast, Bolten, Meinlschmidt, & Hellhammer, 2013). The EPDS has been validated as a depression screening tool in pregnant and postpartum Hispanic women and has a sensitivity of 90%–100% and a specificity of 78%–88% for the identification of depression (Cox et al., 1987; Yonkers et al., 2001). Consistent with previous research, we used the standard cutpoint of 13 or higher (EPDS 13) as well as the alternate cutpoint of 15 or higher (EPDS 15) on the 0–30-point scale to indicate elevated depressive symptoms (Matthey, Henshaw, Elliott, & Barnett, 2006).

## Covariates

During early pregnancy, interviewers collected sociodemographic information (age, education, annual household income, marital status, language preference, generation in the Continental United States), alcohol consumption, cigarette smoking, and physical activity. Perceived stress was measured by Cohen's Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983) and anxiety was measured by the Spielberger State–Trait Anxiety Inventory (Spielberger, 1983). Parity and gestational diabetes were obtained from medical records.

## Data Analysis

We used generalized linear mixed-effects modeling (SAS GLIMMIX) to evaluate the effect of prepregnancy BMI and GWG on the repeated outcome of elevated depressive symptoms across pregnancy; we also tested for an interaction between BMI and GWG in predicting elevated depressive symptoms. We assessed confounding by evaluating changes in the exposure estimate when each covariate was added to the regression model; covariates that led to a change of 10% or greater were included in the final multivariable model. Perceived stress and anxiety were excluded from all the models due to their high correlation with depression ($r = .66$–$0.81$, $p < .01$) (Alder, Fink, Bitzer, Hosli, & Holzgreve, 2007). Finally, we tested for effect modification by two indicators of acculturation: language preference and generation in the U.S. Statistical analyses were conducted using SAS 9.3 (SAS Institute Inc., Cary, North Carolina).

## Results

Participants in Proyecto Buena Salud were young (31% <20 years) with low levels of education (47% <high school) and income (31% $15,000). Almost half of the sample (47%) was born in Puerto Rico or the Dominican Republic, and 45% were overweight or obese before pregnancy. The prevalence of EPDS 13 ranged from 28.4% in early pregnancy to 19.5% in late pregnancy; EPDS 15 ranged from 18.4% in early pregnancy to 13.0% in late pregnancy (see Table 1). A total of 363 women (33.3%) experienced EPDS 13, and 260 (23.9%) experienced EPDS 15 at any point during pregnancy. In multivariable, longitudinal modeling, overweight women had an odds ratio (*OR*) of 0.53 (95% CI [0.31, 0.90]) for EPDS score 13 and 0.51 (95% CI [0.28, 0.91]) for EPDS score 15 as compared to normal weight women (see Table 2). We did not observe an association between being underweight or obese with elevated depressive symptoms. We also did not observe an association between GWG, or an interaction between BMI and GWG, in predicting elevated depressive symptoms (see Table 2). Finally, we detected no effect modification by language preference or generation in the United States.

## Discussion

In this prospective cohort study of Hispanic women, we observed a strong association between prepregnancy overweight and lower odds of elevated depressive symptoms that remained after controlling for potential confounders. There was no statistically significant

association between obesity and elevated depressive symptoms in this cohort. Further, we did not detect an association between GWG and elevated depressive symptoms.

To our knowledge, Bodnar et al. have conducted the only prior study of this topic. The authors did not observe a statistically significant association between prepregnancy overweight and diagnosed depression: $OR$ = 1.7 (95% CI [0.9, 3.4]). However, obese women had an $OR$ of 2.9 (95% CI [1.5–5.6]) compared to normal weight women. The authors also found that risk of depression among women who were underweight or normal weight depended on the adequacy of GWG. Differences in findings may be due to several factors. First, the Bodnar et al. cohort was predominantly White, married, and college-educated. Race/ethnicity and sociodemographic factors may influence body image and weight/shape satisfaction, which are linked to depressive symptoms. For example, low-income Hispanic women have reported lower body image dissatisfaction postpartum compared to Anglo American women (Walker, Timmerman, Kim, & Sterling, 2002). Higher body image satisfaction, in turn, has been related to lower depressive symptoms during pregnancy (Clark et al., 2009; Downs, DiNallo, & Kirner, 2008; Rauff & Downs, 2011). Though we are not able to evaluate this in the current study, we suggest the differences in findings may be due to cultural differences in how weight and weight gain are viewed, particularly in the context of pregnancy. Second, Bodnar et al. used a structured clinical interview to diagnose major depressive disorder, while we used a depressive symptoms scale. While the EPDS is widely used due to its practical clinical utility and high sensitivity and specificity, we cannot rule out the possibility that prepregnancy BMI has a different association with diagnosed major depressive disorder.

There are several limitations of the current study. We did not have information on history of depression, which may have confounded our observed associations. In addition, our analysis of GWG and elevated depressive symptoms was cross-sectional (i.e., the variables were measured at the same time points throughout the pregnancy) limiting our ability to assess temporality between these variables. We observed several trends in our results that were not statistically significant, suggesting variability in responses in our study population.

In summary, given the limited research on this topic, our findings provide preliminary support for a role of prepregnancy BMI in depressive symptoms experienced across pregnancy in Hispanic women.

## Acknowledgments

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**Table 1**

Prevalence of Depressive Symptoms by Prepregnancy Body Mass Index and Total Gestational Weight Gain (n =1,090); Proyecto Buena Salud, Western Massachusetts, 2006–2011

| | Early pregnancy (<18 weeks) | | | | Midpregnancy (18–26 weeks) | | | | Late pregnancy (>26 weeks) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | EPDS 15[a] % | p value[c] | EPDS 13[a] % | p value[c] | EPDS 15[a] % | p value[c] | EPDS 13[a] % | p value[c] | EPDS 15[a] % | p value[c] | EPDS 13[a] % | p value[c] |
| Total sample | 18.36 | | 28.39 | | 18.02 | | 23.87 | | 13.04 | | 19.49 | |
| Prepregnancy Body Mass Index (kg/m$^2$) | | | | | | | | | | | | |
| Underweight (<18.5) | 17.07 | 0.25 | 21.95 | 0.38 | 14.89 | 0.43 | 19.15 | 0.05 | 21.95 | 0.10 | 26.83 | 0.05 |
| Normal (18.5–<25) | 20.81 | | 29.73 | | 19.81 | | 25.24 | | 13.31 | | 20.41 | |
| Overweight (25–<30) | 13.64 | | 24.43 | | 14.00 | | 16.67 | | 8.03 | | 11.68 | |
| Obese (≥30) | 18.23 | | 30.94 | | 19.23 | | 29.49 | | 14.57 | | 22.52 | |
| Total gestational weight gain[b] | | | | | | | | | | | | |
| Below guidelines | 22.94 | <.01 | 31.76 | 0.09 | 19.31 | 0.81 | 26.90 | 0.23 | 16.10 | 0.53 | 22.03 | 0.71 |
| Within guidelines | 23.56 | | 32.46 | | 18.75 | | 26.70 | | 12.95 | | 19.69 | |
| Above guidelines | 14.00 | | 25.06 | | 17.10 | | 21.16 | | 12.08 | | 18.54 | |

*Note.* Numbers indicate the percent of the study population within each weight category with elevated depressive symptoms. BMI =Body Mass Index.

[a] Edinburgh Postpartum Depression Scale (EPDS) scores range from 0 to 30. Scores greater than or equal to 13 and 15 were used to indicate elevated depressive symptoms.

[b] Total gestational weight gain classified as below the lower cut-off of prepregnancy BMI-specific 2009 Institute of Medicine (IOM) weight gain guidelines, within the IOM recommended range, or above the upper cutoff.

[c] p values from Chi-square tests for categorical variables.

**Table 2**

Multivariable Odds Ratios for Elevated Depressive Symptoms During Pregnancy According to Prepregnancy Body Mass Index (n=1,090); Proyecto Buena Salud, Western Massachusetts, 2006–2011

| | EPDS 13[a] | | | | EPDS 15[a] | | | |
|---|---|---|---|---|---|---|---|---|
| | Model 1[b] | | Multivariable model[c] | | Model 1[b] | | Multivariable model[c] | |
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| **Prepregnancy Body Mass Index** | | | | | | | | |
| Underweight (<18.5) | 0.81 | (0.34, 1.91) | 0.81 | (0.35, 1.87) | 1.05 | (0.42, 2.63) | 1.01 | (0.42, 2.45) |
| Normal (18.5–<25) | 1.00 | referent | 1.00 | referent | 1.00 | referent | 1.00 | referent |
| Overweight (25–<30) | 0.52 | (0.31, 0.90) | 0.53 | (0.31, 0.90) | 0.50 | (0.27, 0.91) | 0.51 | (0.28, 0.91) |
| Obese (≥30) | 1.25 | (0.75, 2.07) | 1.12 | (0.68, 1.84) | 0.91 | (0.52, 1.60) | 0.81 | (0.47, 1.39) |
| | Model 1[b] | | Multivariable model[d] | | Model 1[b] | | Multivariable model[d] | |
| | OR | 95% CI | OR | 95% CI | OR | 95% CI | OR | 95% CI |
| **Gestational weight gain[e]** | | | | | | | | |
| Below guidelines | 1.13 | (0.63, 2.04) | 0.91 | (0.52, 1.62) | 1.24 | (0.66, 2.33) | 1.00 | (0.54, 1.85) |
| Within guidelines | 1.00 | referent | 1.00 | referent | 1.00 | referent | 1.00 | referent |
| Above guidelines | 0.66 | (0.41, 1.08) | 0.72 | (0.45, 1.17) | 0.66 | (0.39, 1.13) | 0.78 | (0.46, 1.30) |

*Note.* BMI =Body Mass Index.

[a] Edinburgh Postpartum Depression Scale (EPDS) scores range from 0–30. Scores greater than or equal to 13 and 15 were used to indicate elevated depressive symptoms. Odds ratios (ORs) and 95 % Confidence Intervals (CIs) calculated from random intercept logistic regression models.

[b] Adjusted for gestational age at depression assessment.

[c] Additionally adjusted for age, education, marital status, annual household income, health insurance, generation in the United States, language preference, and parity (for EPDS 13 only).

[d] Additionally adjusted for age, education, annual household income, generation in the United States, prepregnancy BMI, total physical activity, smoking, alcohol consumption, language preference, parity (for EPDS 15 only), marital status (for EPDS 13 only), and health insurance (for EPDS 13 only).

[e] Total gestational weight gain classified as below the lower cut-off of prepregnancy BMI-specific 2009 Institute of Medicine (IOM) weight gain guidelines, within the IOM recommended range, or above the upper cutoff.