

# Pre-pregnancy Body Mass Index and Third-Trimester Depressive Symptoms in a Healthy Privately Insured Sample

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## Abstract

**Objectives** While being overweight (body mass index [BMI] >25) prior to pregnancy is linked to antenatal depression, whether weight is confounded by socioeconomic and/or medical risks is unclear.

**Study Design** We assessed 66 healthy privately insured pregnant women at M = 35.0 ± 3.3 weeks for symptoms of depression (Inventory for Depressive Symptoms—Self-Report [IDS-SR 30]), lifetime history of depression and other psychiatric conditions (Mini International Neuropsychiatric Interview), and pre-pregnancy BMI derived from pre-pregnancy weight (by recall) and directly measured height. Pre-pregnancy overweight (BMI > 25) and antenatal depression (score of mild or greater [14] on the IDS-SR 30) were assessed using logistic regression, controlling for past major depressive disorder (MDD) and demographic factors showing significant between group differences.

**Results** Pre-pregnancy overweight ( $n = 17$ ; 25.8%) was associated with an increased risk of third trimester depression, independent of past MDD and marital status (odds ratio = 7.47; 95% confidence interval [2.09–26.68];  $B$  (standard error) = 2.010 [0.650]).

**Conclusion** Replication in a larger sample is suggested to confirm an independent effect of pregravid overweight on third trimester depression.

## Keywords

- ▶ oxytocin
- ▶ overweight
- ▶ pregnancy
- ▶ postpartum depression

The prevalence of overweight or obesity, defined as a body mass index (BMI) of 25 to 30, or > 30 kg/m<sup>2</sup>, respectively, among women who conceive in the United States is significant and rapidly rising. One-third of women are overweight at the time of conception, and one in five are obese.<sup>1</sup> Elevated pre-pregnancy BMI has been linked to a variety of adverse obstetric outcomes including but not limited to preeclampsia, hypertension, gestational diabetes, and birth defects.<sup>2–4</sup>

Pre-pregnancy overweight and obesity also increase the risk of another common, but less studied pregnancy complication—antenatal depression, or the onset of depressive symptoms in women while pregnant.<sup>5</sup> There is increasing attention to the identification and treatment of antenatal depression<sup>6</sup> due in part to a growing recognition of the short- and long-term impact of intrauterine exposure to maternal depression on child outcomes.<sup>7</sup> Within this context, the

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identification of modifiable risk factors for antenatal depression could enable early detection and even prevention of this common complication of child-bearing.

Overweight is a well-established risk factor for depression in nonpregnant individuals. In pregnant women, elevated pre-pregnancy BMI appears to increase the risk of depression illness in a dose-dependent fashion.<sup>8</sup> However, the link between pre-pregnancy BMI and depression in pregnancy could have etiologic contributions from weight-related non-psychiatric illnesses and socioeconomic status (SES),<sup>9</sup> associated with both obesity and depression.<sup>10</sup> To isolate whether pregravid overweight predicts antenatal depressive symptoms independent of SES and weight-related illnesses (diabetes, hypertension, heart disease), we analyzed data from an existing cohort of healthy, privately-insured pregnant women recruited from a large urban academic medical center. Specifically, we examined the relationship between pre-pregnancy overweight and third-trimester depressive symptoms. We secondarily examined (1) whether depressive symptoms were related to gestational weight gain and (2) the specific depressive symptoms that were most strongly associated with pre-pregnancy weight.

## Materials and Methods

### Sample

Participants were 66 predominantly married, privately insured, pregnant women who were taking part in a longitudinal study about third-trimester plasma oxytocin and postpartum depression. Data for the current study include information collected during initial screening and third-trimester visits ( $M = 35.0$  weeks;  $SD = 3.3$ ). Inclusion criteria were age of 18 years or older, English literacy, and third-trimester singleton pregnancy. As the parent study aimed to replicate and expand on previous work on oxytocin and perinatal mood,<sup>11</sup> potential participants with a  $BMI > 32$  were excluded. Additional exclusion criteria were (1) any medical illness prior to or during pregnancy including diabetes, hypertension, sleep apnea, or thyroid disease; (2) any current treatment for depression or anxiety (either with antidepressants or psychotherapy); (3) fetal malformation; and (4) cigarette smoking beyond the 10th week of gestation.

### Recruitment and Procedures

A research assistant recruited participants from the waiting area of the academic faculty obstetric clinic that serves exclusively privately insured patients by assessing interest in “a study about oxytocin and mood.” Brochures, online advertisements, and flyers were also placed throughout the medical center, affiliated clinics, and in local businesses close to the medical campus. Women who met inclusion and exclusion criteria through initial screening (by phone, for participants responding to advertisements, and in person, for those recruited from the clinic) were invited for baseline assessments.

At screening, pre-pregnancy weight was obtained via self-report from participants. Current height and weight were

measured directly by a research nurse. Current depressive symptoms were assessed using the Inventory for Depressive Symptoms—Self-Report 30 (IDS-SR 30)<sup>12</sup> which is categorized according to severity: 0 to 13 = normal; 14 to 25 = mild depression, 26 to 38 = moderate depression; 39 to 48 = severe depression, and 49 to 84 = very severe depression.<sup>13</sup> The IDS-SR has been previously validated for use in assessing depression among pregnant women.<sup>14</sup> Due to the importance of early detection of perinatal depression, we focused on the presence of any depression, however, mild. Thus, we utilized a score of 14 or higher to define the presence of depressive symptoms during pregnancy. The Mini International Neuropsychiatric Interview Version 5.0.0. (MINI)<sup>15</sup> was administered by study psychiatrists to determine lifetime history of major depressive episodes and other psychiatric conditions. All procedures were approved by the Institutional Review Board of the university where this study was conducted.

### Analysis

BMI was calculated from measured height and pre-pregnancy weight ( $BMI = \text{weight [kg]} / \text{height [m}^2\text{]}$ ). A binary variable was created to reflect pre-pregnancy overweight status, defined as a  $BMI \geq 25$  (U.S. Department of Health and Human Services, 2015). Based on an IDS-SR 30 score of  $\geq 14$ , a binary variable was created to reflect the presence of depressive symptoms. Gestational weight gain through the third trimester was calculated by subtracting pre-pregnancy weight from weight measured at the third-trimester visit. Demographic and clinical characteristics were compared between pre-pregnancy overweight and pre-pregnancy not overweight groups using *t*-tests and chi-square tests for continuous and binary variables, respectively. The association between pre-pregnancy overweight (independent variable) and third-trimester depressive symptoms (dependent variable) was assessed using logistic regression analysis, with past major depressive disorder (MDD) (as determined by the MINI) entered as a covariate. The presence of multicollinearity among factors was ruled out using bivariate correlation analysis. Finally, relationships among pre-pregnancy BMI, gestational weight gain, and specific depressive symptoms reported in the IDS-SR 30 were explored using bivariate correlation analysis.

## Results

Racial and ethnic breakdown were non-Hispanic Caucasian 72.7% ( $n = 48$ ); African American 10.6% ( $n = 7$ ); Asian 9.1% ( $n = 6$ ); and Hispanic 7.6% ( $n = 5$ ). The distribution of pre-pregnancy BMI in this sample was underweight ( $BMI < 18.5$ ) = 4.5% ( $n = 3$ ); normal weight ( $BMI 18.5\text{--}24.9$ ) = 68.2% ( $n = 46$ ); overweight ( $BMI 25\text{--}29.9$ ) = 16.7% ( $n = 11$ ); and obese ( $BMI \geq 30\text{--}32$ ) = 10.6% ( $n = 6$ ). One in five participants ( $n = 13$ ) had a prior major depressive episode (MINI); the length of time between prior episode and the current pregnancy ranged from 2 to 12 years. Other past psychiatric diagnoses were panic disorder ( $n = 2$ ), posttraumatic stress disorder ( $n = 1$ ), obsessive-compulsive disorder ( $n = 1$ ),

**Table 1** Characteristics of participants by pregravid overweight status (BMI  $\geq$  25)

	Total (N = 66)	Not overweight (n = 49)	Overweight (n = 17)
Age (y)	33.0 (4.9)	33.0 (4.4)	33.0 (6.2)
Gestational age (wk)	35.0 (3.3)	34.8 (3.3)	35.7 (3.3)
Unmarried	12.1%	6.1% <sup>a</sup>	23.5% <sup>a</sup>
Multiparous	55.4%	63.4%	41.2%
Racial/ethnic minority	30.3%	26.5%	41.2%
Pregravid BMI (kg/m <sup>2</sup> )	23.2 (3.7)	21.3 (1.8) <sup>b</sup>	28.5 (2.2) <sup>b</sup>
Weight gained to date (lbs)	30.0 (10.1)	30.8 (9.7)	29.8 (12.4)
Current BMI (kg/m <sup>2</sup> )	28.3 (4.2)	26.3 (2.5) <sup>b</sup>	33.9 (2.8) <sup>b</sup>
Lifetime MDD <sup>c</sup>	20.0%	22.4%	11.8%
Lifetime psych dx <sup>c</sup>	29.2%	30.6%	17.6%
Current depression <sup>d</sup>	34.8%	24.5% <sup>b</sup>	64.7% <sup>b</sup>

Abbreviations: BMI, body mass index; MDD, major depressive disorder.

<sup>a</sup> $p = < 0.05$ .

<sup>b</sup> $p = < 0.01$ .

<sup>c</sup>Mini International Neuropsychiatric Interview Version 5.0.0 regarding history prior to pregnancy.

<sup>d</sup>Inventory of Depressive Symptoms–Self-Report 30 item version score  $\geq$  14 suggestive of least mild depression.

generalized anxiety disorder ( $n = 1$ ), alcohol abuse ( $n = 1$ ), alcohol dependence ( $n = 1$ ), marijuana abuse ( $n = 1$ ), and antisocial personality disorder ( $n = 1$ ). Descriptive characteristics of pre-pregnancy overweight/obesity and normal weight women are shown in ►Table 1. Overweight/obese women were significantly more likely to be unmarried.

Prior major depression and pre-pregnancy overweight status were associated with third-trimester depression (►Table 2) and together accounted for a quarter of the variance (Nagelkerke's  $R^2 = 0.248$ ). Pre-pregnancy overweight/obesity was associated with an approximately sevenfold increase in the likelihood of third-trimester depression. Gestational weight gain was unrelated to third-trimester depressive symptoms ( $r = -0.009$ ,  $p = 0.953$ ). Pre-pregnancy overweight/obesity was significantly correlated with the IDS-SR 30 item, "waking up too early" ( $r = 0.267$ ,  $p = 0.030$ ) but not with other items.

## Discussion

Although overweight and depression are more prevalent among socioeconomically disadvantaged women,<sup>16</sup> there is recent evidence that the relationship between BMI and antenatal depression occurring during gestation is stronger

among women with higher SES.<sup>17</sup> In this study, we present preliminary evidence between pre-pregnancy overweight and depressive symptoms in the third trimester among predominantly high SES pregnant women without any medical comorbidities. This relationship held after controlling for lifetime depressive disorder, which itself, conferred a fourfold increase in risk for antenatal depression consistent with studies in much larger samples.<sup>18</sup> There are numerous mechanisms linking obesity to depression including but not limited to inflammation,<sup>19–21</sup> hormonal dysregulation,<sup>22</sup> sleep disturbance,<sup>23</sup> and psychosocial factors such as body dissatisfaction, particularly among women.<sup>24</sup> We noted a significant correlation between endorsement of insomnia (early waking) on the IDS-SR 30 and depression. While this is by no means a formal measure of sleep disturbance, significant overlaps in sleep disturbance, obesity, and depression are well known.<sup>25,26</sup> Understanding how these factors interact during pregnancy in a prospective study would be informative to identify key targets for preventive interventions.

## Limitations

As is common for secondary analysis studies, there are several limitations that threaten to bias our findings. These include reliance of self-reports of pre-pregnancy weight,

**Table 2** Logistic regression  $R^2$  model of factors associated with third-trimester depressive symptoms<sup>a</sup>

	B	SE	Wald	df	Sig	OR	95% CI for OR
Unmarried	−0.001	0.952	0.000	1	1.000	0.999	0.155–6.460
Prior MDD <sup>a</sup>	1.444	0.705	4.193	1	0.041	4.239	1.064–16.893
Pregravid overweight/obesity <sup>b</sup>	2.010	0.670	9.006	1	0.003	7.467	2.009–27.758

Abbreviations: CI, confidence interval; MDD, major depressive disorder; OR, odds ratio; SE, standard error.

<sup>a</sup>Past MDD, determined by the Mini International Neuropsychiatric Interview Version 5.0.0.

<sup>b</sup>Defined as pregravid body mass index of  $\geq$  25.

restriction of the sample to women with a BMI of less than 32, and an elevated prevalence of past MDD (20%) and any past psychiatric condition (29.2%) in this sample. However, each of these limitations would be expected to reduce, not magnify the strength of the relationship we found. Specifically, women who were overweight prior to pregnancy would be expected to underestimate their pre-pregnancy weight, thereby restricting the variance in pre-pregnancy BMI. Similarly, restriction of BMI to <32 (required for a study on plasma oxytocin) should further reduce variance in pre-pregnancy BMI. Even with this limited range, we detected a robust effect of pre-pregnancy overweight on prenatal depressive symptoms. Finally, we considered possible confounding of the pre-pregnancy overweight-antenatal depression link by past MDD. However, as shown in **Table 1**, the prevalence of past MDD and past psychiatric disorders was actually higher in women who were not overweight before pregnancy. In these ways, we have reason to believe in the validity of our results.

There are also alternative explanations for the relationship between pre-pregnancy overweight and antenatal depression. We considered that bodily discomfort in the third trimester could be more prominent in women who gained a large amount of weight during pregnancy. However, as shown in **Table 1**, the amount of weight gained during pregnancy between groups was nearly identical. A further *post hoc* analysis of pre-pregnancy BMI and IDS-SR 30 items reflecting somatic discomfort (heaviness, pain, lethargy) did not reveal significant correlations. Finally, the relationship found in this study between pre-pregnancy overweight and antenatal depression is higher than reported in existing studies of women with similar SES.<sup>17</sup> Thus, our sample may not be representative and could reflect the unique attributes of women who seek obstetric care at an academic medical center located in a large city.

## Conclusion

Excessive weight prior to pregnancy in the overweight to mild obesity range may be an independent risk factor for depressive symptoms during pregnancy, independent of SES, weight-related illnesses, and past depressive episodes. Replication of these results in a larger sample would be important in light of potential implications for prevention.

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### Conflict of Interest

The Department of Psychiatry at Northwestern University receives contractual fees for Dr. Wisner's consultation to Quinn Emanuel Urquhart & Sullivan, LLP (New York City), who represent Pfizer Pharmaceutical Company.

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