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Association of antepartum depression, generalized anxiety, and posttraumatic stress disorder with infant birth weight and gestational age at delivery

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Abstract

Background: Low- and middle-income countries bear a disproportionate burden of preterm birth (PTB) and low infant birth weight (LBW) complications where affective and anxiety disorders are more common in the antepartum period than in industrialized countries.

Objective: To evaluate the extent to which early pregnancy antepartum depression, generalized anxiety disorder, and posttraumatic stress disorder (PTSD) are associated with infant birth weight and gestational age at delivery among a cohort of pregnant women in Peru.

Methods: Our prospective cohort study consisted of 4,408 pregnant women. Antepartum depression, generalized anxiety, and PTSD were assessed in early pregnancy using the Patient

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Health Questionnaire-9, Generalized Anxiety Disorder Scale-7 and PTSD Checklist – Civilian Version, respectively. Pregnancy outcome data were obtained from medical records. Multivariable linear and logistic regression procedures were used to estimate adjusted measures of association (β coefficients and odds ratios) and 95% confidence intervals (CI).

Results: After adjusting for confounders, women with antepartum generalized anxiety (32.6% prevalence) had higher odds of LBW (adjusted odds ratio (OR)=1.47; 95%CI: 1.10-1.95) and were more likely to deliver small for gestational age (OR=1.39; 95%CI: 1.01-1.92) infants compared to those without anxiety. Compared to those without PTSD, women with PTSD (34.5%) had higher odds of delivering preterm (OR=1.28; 95%CI: 1.00-1.65) yet PTSD was not associated with LBW nor gestational age at delivery. Women with antepartum depression (26.2%) were at no increased risk of delivering a preterm, low-birth-weight or small-for-gestational-age infant.

Limitations: Our ability to make casual inferences from this observational study is limited; however, these findings are consistent with prior studies.

Conclusion: Generalized anxiety disorder during pregnancy appeared to increase odds of delivering a low-birth-weight or small-for-gestational-age infant, while PTSD was associated with increased odds of delivering preterm. Our findings, and those of others, suggest antenatal care should be tailored to screen for and provide additional mental health services to patients.

Keywords

depression; anxiety; posttraumatic stress disorder; pregnancy; preterm delivery; birth weight

Introduction

Low infant birth weight (LBW) and preterm birth (PTB) are the major causes of neonatal and child mortality (under 5 years of age) worldwide.[1] Approximately 1 million preterm infants die in the neonatal period each year and many of those who survive face lifelong disability.[2] LBW and PTB are also major causes of pediatric morbidity including respiratory distress syndrome, necrotizing enterocolitis, and intraventricular hemorrhage and developmental delays.[3-5] For instance, compared with term infants, preterm infants are at increased risks for immediate and long-term health problems, [6, 7] including increased risk of later-life cardiovascular-related conditions.[8-10] According to the World Health Organization, the global prevalence of LBW infants is estimated to range from 15% to 20% of all births [11] and approximately 11% of children are born preterm worldwide.[1] In high-income countries, improvements in neonatal care, the introduction of advanced technology, and changing attitudes toward intensive care have resulted in marked increases in the survival rate of LBW and preterm infants. [12, 13] However, low- and middle-income countries (LAMICs) continue to bear a disproportionate burden of LBW and PTB. [1] Notably, a systematic review and modeling analysis estimated that there were 14.8 million PTBs in LAMICs in 2014.[14] Another report estimated 32.4 million infants were born small for gestational age (SGA) in LAMICs.[15]

There is a growing body of epidemiologic evidence, although not conclusive, [16] identifying common antepartum mental disorders (i.e., depression, anxiety, and stress) as risk factors for PTB and LBW.[17-20] Prior research from our group has shown that

exposure to childhood abuse and experiences of intimate partner violence are associated with antepartum mental disorders. For instance, women who experienced intimate partner violence (OR=2.60; 95% CI: 0.91-11.19) and childhood abuse (OR=5.73; 95% CI, 2.99-10.98) were more likely to report PTSD symptoms compared to women with no history of abuse.[21] Other risk factors include low socioeconomic status at the time of pregnancy, [22-24] lack of social support [25] and history of mental health problems. [26] Prior literature shows maternal posttraumatic stress disorder (PTSD) is associated with infant outcomes including PTB and LBW.[27, 28] However, most previous studies are focused on women residing in high-income countries, thus leaving a gap in knowledge concerning women residing in LAMICs. [29] This gap is poignant when the substantially higher prevalence of maternal depression, anxiety, and PTSD in LAMICs is considered. [30-32] Given the (i) high burden of maternal psychiatric disorders in LAMICs, [30-32] (ii) gaps in knowledge, and (iii) evidence that mental health services when provided during the antepartum period may mitigate the risk of adverse pregnancy outcomes, [30-32] we sought to evaluate the extent to which early pregnancy antepartum depression, generalized anxiety disorder, and PTSD were associated with infant birth weight (BW) and gestational age (GA) among a cohort of pregnant women in Lima, Peru.

Methods

Study Population

The population for the present study was drawn from participants of the Pregnancy Outcomes, Maternal and Infant Study (PrOMIS) cohort. The PrOMIS cohort examined maternal social and behavioral risk factors of preterm birth and other adverse pregnancy outcomes among Peruvian women and was conducted between February 2012 and November 2015. The methodology and study procedures have been described previously. [33] Briefly, the Instituto Nacional Materno Perinatal (INMP) de Lima, Peru is a national reference institution for pregnant women. The study population consists of women attending prenatal care clinics at the INMP hospital. Women were eligible for inclusion if they were 18 years of age, 16 weeks of gestation, and could speak and read Spanish. Enrolled participants were invited to take part in an interview where trained research personnel used a structured questionnaire to elicit information regarding maternal socio-demographics, lifestyle characteristics, and symptoms of mood and anxiety. The questionnaire, originally written in English, was translated into Spanish by a team of native Spanish speakers with experience in sleep research. To ensure proper expression and conceptualization of terminologies in local contexts, the translated version was back-translated and modified until the back-translated version was comparable with the original English version. The institutional review boards of the INMP and the Office of Human Research Administration, Harvard T.H. Chan School of Public Health, Boston, MA approved all study procedures. All participants provided written informed consent.

Antepartum Depression

Antepartum depression was assessed using the Patient Health Questionnaire (PHQ-9) a nine-item, self-reported depression measure from the Primary Care Evaluation of Mental Disorders [34, 35] diagnostic instrument. The instrument assesses nine depressive

symptoms, namely, anhedonia, depressed mood, trouble sleeping, feeling tired, change in appetite, guilt, or worthlessness, concentration problems, psychomotor agitation/retardation, and suicidal thoughts, experienced over the last two weeks (14 days). The PHQ-9 score was calculated by assigning a value of 0, 1, 2, or 3, to the response categories of “not at all”, “several days”, “more than half the days” and “nearly every day,” respectively. As a severity measure, the total score of PHQ-9 scores range from 0 to 27. Depression was defined as score of 10 or greater. [34] The PHQ-9 has been validated in Spanish-speaking and pregnant populations. [36, 37]. The PHQ-9 was found to have good reliability among study participants in the PrOMIS cohort (Cronbach’s alpha = 0.81 [38].

Antepartum Generalized Anxiety

The GAD-7 questionnaire was developed to identify probable cases of generalized anxiety disorder and measure the severity of generalized anxiety symptoms. [39] The GAD-7 assesses the most prominent diagnostic features (diagnostic criteria A, B, and C from the *Diagnostic and Statistical Manual of Mental Disorders*, fourth edition [DSM-IV]) for generalized anxiety disorder. [40, 41] The GAD-7 has been previously used in Spanish-speaking populations. [42] Among PrOMIS cohort participants, the GAD-7 has been found to have good reliability (Cronbach’s alpha = 0.89) [43]. The GAD-7 consists of seven questions about symptoms of general anxiety disorder over the past two weeks on a four-point scale: “never,” “several days,” “more than half the days,” or “nearly every day.” Items include: nervousness, inability to stop worrying, excessive worry, restlessness, difficulty in relaxing, easy irritation, and fear of something awful happening. The total score of GAD-7 ranges from 0 to 21, with increasing scores signifying a stronger association with functional impairments as a result of anxiety. [44] Based on a validation study performed among Spanish-speaking pregnant women, generalized antepartum anxiety disorder, herein after referred as generalized anxiety, was defined as a GAD- total score of seven or greater (sensitivity=73.3%; specificity=67.3%). [33]

Antepartum PTSD

The PTSD Checklist-Civilian Version (PCL-C) is a 17-item self-report measure from the DSM-IV criteria. Participants are asked how bothered they are by symptoms of their most significant life event stressor on a 5-point Likert scale ranging from 1: “not at all” to 5: “extremely” over the past month. The total score of the PCL-C ranges from 17-85. Based on a validation study conducted within the PrOMIS cohort (Cronbach’s alpha = 0.90), PTSD was defined with a PCL score of 26 or greater (sensitivity=86%; specificity=63%). [45, 46].

Pregnancy Outcomes Assessment

Pregnancy outcome data, including birth weight (BW) and gestational age at delivery (GA), were obtained from medical records. Guidelines from the American College of Obstetricians and Gynecologists were used for diagnosis of preterm delivery. [47] Gestational age was based on the date of last menstrual period and confirmed by an ultrasound performed during perinatal visits before 20 weeks gestation. Preterm delivery was defined as delivery before the completion of 37 weeks of gestation. Low birth weight was categorized as <2500 g. Infant size was classified as follows: small for gestational age (SGA), appropriate for gestational age (AGA), and large for gestational age (LGA). Infants were classified as SGA

when their size at birth is below the 10th percentile, AGA when between the 10th and 90th percentiles, and LGA when above the 90th percentile. It was not limited to term or preterm. [48]

Covariates

Interviews contained questions about sociodemographic and reproductive characteristics including maternal age at interview (18-20, 20-29, 30-34, 35 years), educational attainment (<7-12, >12 years), race/ethnicity (Mestizo vs. others), marital status (married/living with a partner vs. others), employment status (employed vs. unemployed), access to basic foods (very hard/hard/somewhat hard vs. not very hard), parity (multiparous vs. nulliparous), planned vs. unplanned pregnancy, gestational age at interview (in weeks), early pregnancy body mass index (BMI) based upon directly measured weight and height (in kg/m²), and infant sex.

Statistical Analysis

Among the 5,440 women interviewed, 4,472 had live births and 31 stillbirths. Of these, 64 (1.4%) participants were excluded from analysis due to missing information on the PHQ-9, GAD-7, or PCL-C. The final dataset included 4,408 pregnant women and their singleton newborns. Frequency distributions of maternal sociodemographic and reproductive characteristics were examined as mean $\pm$ standard deviation (SD) for continuous variables and number (%) for categorical variables.

Multivariable linear and logistic regression procedures were used to calculate maximum likelihood estimates of odds ratios (ORs), beta coefficients (β), and 95% confidence intervals (CIs) of low birth weight and small for gestational age (each expressed as dichotomous variables) in relation to antepartum depression, generalized anxiety, or PTSD. Since the outcomes are rare in the source populations (<10 %), the results of odds ratios will not be materially different from risk ratios. In this model, we included covariates of *a priori* interest (i.e., maternal age, parity, early pregnancy BMI, and infant sex) on the basis of their hypothesized relationship with antepartum mental disorders and infant outcomes. We included confounders of *a priori* interest or those that changed the model by more than 10%. [49] Statistical analyses were performed using IBM SPSS Statistics Version 24.0 (IBM Corporation). Reported *P*-values are 2-tailed with the statistical significance set at 0.05.

Results

Participant characteristics

Sociodemographic and reproductive characteristics of the 4,408 participants are summarized in Table 1. The mean age of participants was 27.91 years (SD = 6.11) with the majority between 20 to 29 years old (56.7%). Among all participants, 47.2% had more than 12 years of education, 77.8% identified as Mestizo, 82.2% were married or living with a partner, 46.9% reported difficulty accessing basic foods, 48.2% were nulliparous, and 40.6% had planned the current pregnancy. The prevalence of antepartum depression, generalized anxiety, and PTSD were 26.2%, 32.6%, and 34.5%, respectively. The prevalence of LBW and PTB were 4.9% and 6.3%, respectively (Table 1). Compared to participants who

reported no depression and no generalized anxiety, participants who endorsed both depression and generalized anxiety were less likely to be from Mestizo ethnicity (67.6 vs 80.6%), less likely to be married (78.5% vs 82.7) and less likely to have planned pregnancies (35.3% vs 43.7%) (Supplemental Table 1).

Associations of antepartum mental disorder with low birth weight

Compared with women reporting no antepartum depression, those with depression did not have elevated odds of delivering an LBW infant (aOR=1.01; 95% CI = 0.74-1.39) after adjusting for maternal age, parity, early pregnancy BMI, difficulty paying for the basics, and infant sex. Women with generalized anxiety had 1.47-fold higher odds of delivering an LBW infant (aOR=1.47; 95% CI:1.10-1.95) compared to women with no generalized anxiety. After adjusting for confounders (cited above), women with PTSD had 1.26-fold higher odds of delivering an LBW infant compared to those without PTSD (aOR=1.26; 95% CI = 0.94-1.68; Table 2) although not statistically significant.

Examining birth weight in continuous form in adjusted models showed that women with antepartum depression had infants that weighed 23.42 grams less (95% CI:59.50, 12.67, p-value = 0.203) than infants born to women reporting no depression (Table 3). Women with generalized anxiety delivered infants whose birth weight was 46.32 grams less (95% CI: -80.26, -12.39, p-value = 0.007) compared to women reporting no generalized anxiety. Women with reported PTSD delivered infants that weighed -18.14 grams less (95% CI: 51.66, 15.38, p-value = 0.289; Table 3).

Associations of antepartum mental disorder with preterm birth

As presented in Table 4, women who reported PTSD had 1.28-fold higher odds of having a PTB (aOR=1.28; 95% CI: 1.00-1.65) compared to women reporting no antepartum PTSD. The odds of PTB was not elevated for women reporting depression (aOR = 1.02; 95% CI: 0.77-1.35) nor generalized anxiety (aOR = 1.25; 95%CI: 0.97-1.62). Women who reported generalized anxiety delivered infants 0.15 weeks earlier on average (95% CI:0.27, -0.04, p-value = 0.010) compared to women reporting no generalized anxiety.

The association was not significant for women with depression ($\beta = -0.04$, 95%CI = -0.17, 0.08, p-value = 0.507 (Table 5). Women who reported PTSD delivered infants 0.13 weeks earlier on average (95% CI:-0.25, -0.01, p-value = 0.029) compared to women reporting no PTSD.

In adjusted models, women with generalized anxiety had 1.39-fold higher odds of delivering a SGA infant (95% CI: 1.01-1.92) compared to women with no generalized anxiety (Table 6). The association was not statistically significant among women reporting depression (aOR = 0.87, 95% CI: 0.61-1.25) or PTSD (aOR = 0.97, 95% CI: 0.70-1.35).

Discussion

In our cohort of Peruvian pregnant women, the prevalence of antepartum depression, generalized anxiety, and PTSD were 26.2%, 32.6%, and 34.5%, respectively. After adjusting for confounders, women with antepartum generalized anxiety had higher odds of LBW,

PTB, and SGA infants compared to those without generalized anxiety. We found little evidence of higher odds of LBW, PTB, and SGA associated with antepartum depression. Compared to women without PTSD, those with antepartum PTSD had higher odds of PTB. The associations were weaker for LBW and SGA.

Our finding of no association between antepartum depression and LBW or PTB is not consistent with prior research investigating these associations. Some investigators,[50], [51-55] though not all, have shown that women with prenatal depressive disorders are more likely to have LBW infants or a PTB as compared with their counterparts without such depressive disorders.[50, 51, 56] Sanchez *et al.* in their case-control study of Peruvian women, found that antepartum depression was associated with higher odds of PTB (OR=3.67; 95% CI 2.09-6.46).[56] Rahman *et al.* in their study of Pakistani women, found that women with antepartum depression were 1.9-times as likely to deliver LBW infants (OR=1.90; 95% CI: 1.30-2.90) as compared with non-depressed women.[51] Similarly, Wado *et al.* in their cross-sectional study of Ethiopian women, reported those with antepartum depression were 1.87-times as likely to have LBW infants (OR=1.87; 95% CI: 1.09-3.21) compared with non-depressed women.[50] In a meta-analysis, use of antidepressant medications during pregnancy was associated with increased risk of LBW (RR: 1.44, 95%CI: 1.21-1.70) and PTB (RR: 1.69, 95% CI: 1.52-1.88). [57] However, other investigators have found no increased odds of PTB in relation to antepartum depression. Potential reasons posited for null findings in prior studies have been confounding by illicit substances and other psychosocial conditions such as exposure to trauma and violence [58] although these reasons are unlikely to explain our observed findings. Self-reported illicit drug use in our study population is only 0.5%. Adjustment for exposure to childhood and adulthood experiences of violence and trauma did not materially change observed results.

Our study supports previous research on the association of antepartum anxiety and PTSD with birth outcomes. A meta-analysis of twelve studies showed that antepartum anxiety was associated with increased risk of PTB (pooled RR = 1.50; 95% CI = 1.33-1.70) and LBW (pooled RR = 1.76; 95% CI = 1.32-2.33).[59] Similarly, in our population, women who reported generalized anxiety had 1.25-fold higher odds of PTB (95% CI = 0.97-1.62) and delivered infants whose birth weight decreased by 46.32 grams (95% CI = -80.26, -12.39, p-value = 0.007). In our study, women with PTSD had higher odds of PTB (OR=1.28; 95%CI: 1.00-1.65) and delivering LBW infants (OR=1.26; 95% CI: 0.94-1.68). A review article showed that some, but not all, previous studies demonstrated an association of maternal antepartum PTSD with preterm birth and fetal growth [27]. Among women in the US (N=1,093), those with antepartum PTSD has higher odds of preterm contractions (OR=1.4, 95% CI: 1.1- 1.9), and excessive fetal growth (OR=1.5, 95% CI: 1.0-2.2) [60]. Among pregnant teenagers in Brazil (N=795), PTSD was independently associated with low birth weight (prevalence ratio = 1.91; 95% CI:1.01-3.63) [61]. However, in a cohort of women in the US (N=1,100), the odds of preterm delivery was 2.8 times higher among women with PTSD as compared to those without the condition, although the association was imprecise (OR= 2.82, 95% CI: 0.95-8.38) [62].

A number of mechanisms have been proposed by which antepartum mental disorders may contribute to increased risk of LBW or PTB. Anxiety and PTSD have been shown to be

associated with hypothalamic-pituitary-adrenal (HPA) axis hyperactivity [63-65]. Furthermore, investigators have reported that maternal HPA axis dysregulation is associated with adverse perinatal outcomes.[66] When triggered by stressors, the HPA axis stimulates the secretion of cortisol throughout the body. Cortisol, a glucocorticoid hormone released by the HPA axis, is involved in the mobilization of energy stores and immune system modulation,[67, 68] [69] which in combination help the stressed organism adapt and respond to such triggers.[70] Mood disorders may cause an increase in the release of CRH from the placenta via the actions of catecholamines and cortisol.[71] Mood disturbances in the late antenatal period were more frequent than in the postnatal period; this prevalence correlated with higher hormone levels and suggested a role for CRH and the HPA axis in the relationship between antenatal mood states and LBW and PTB.[71] Additional evidence implicates pro-inflammatory cytokines in the pathogenesis of psychiatric disorders, particularly major depression.[72] Catecholamines may facilitate inflammation through induction of interleukins, tumor necrosis factor-alpha, and C-reactive protein which may contribute to LBW and PTB.[72] Finally, in addition to the biological mechanisms cited, behavioral mechanisms may also account for the observed associations. For example, women with antepartum mental disorders may face stigma and thus may be less likely to receive adequate prenatal care which could contribute to increased risks of adverse perinatal outcomes [73]. More research that elucidates the association between maternal psychopathology and risk of PTB and LBW is warranted.

Our present study has several strengths. First, antepartum depression, generalized anxiety disorder, and PTSD were based on reports made early during pregnancy, so reporting was not conditional on infant outcomes (PTB and LBW). Other strengths include well-trained interviewers administering structured questionnaires previously validated among pregnant women. However, there are limitations that merit consideration when interpreting the results of our study. First, data collection was based on self-report, that may lead to non-disclosure or recall bias. Second, mental health outcomes were based on information collected validated screening questionnaires with good to excellent psychometric properties in the present study population. Use of brief screening questionnaires is the most feasible method of data collection for large-scale epidemiologic studies. Nevertheless, we note that future studies which systematically diagnostic tests to ascertain maternal mood and anxiety disorders will be less susceptible to misclassification of maternal psychiatric diagnoses than our present study. Although we controlled for potential confounders, there remains the possibility of residual confounding by unmeasured factors which may have influenced our results. Since generalized anxiety and PTSD symptoms are often comorbid with depression, the independent effect of each disorder was not assessed. Lastly, results from this antenatal-care study may not be generalizable to the entire population of the Peruvian pregnant women.

Our results show symptoms of antepartum depression, generalized anxiety and PTSD are highly prevalent and are associated with higher odds of LBW, PTB, and SGA. Antenatal screening and provision of additional mental health services and care through strategic health investments by the government of Peru has made significant progress in decreasing maternal and infant mortality since the late 1990s.[74] Despite these efforts, mandatory psychiatric consultations for pregnant women have not resulted in improved access to

antenatal mental health care.[75] Our findings and the findings of other studies [27, 28] support increased public health efforts to screen and treat mental disorders among pregnant women as prevention for poor birth outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

- There is a growing body of evidence supporting screening of psychiatric disorders as risk factors for infant outcomes. But limited evidence exists from lower-income settings.
- Our findings show antepartum depression, generalized anxiety and posttraumatic stress disorder (PTSD) are highly prevalent among pregnant Peruvian women.
- Antenatal generalized anxiety increases the odds of delivering a lower birth weight or small gestational aged infant while PTSD is associated with increased odds of delivering preterm.
- Our findings, and those of others, suggest antenatal care should be tailored to screen for and provide additional mental health services to patients.

Table 1:

Sociodemographic and reproductive characteristics of the population (N=4,408)

Characteristics	All participants (N=4,408)	
	n	%
Age (years) ^I	27.91 ± 6.11	
Age (years)		
18-20	244	5.5
20-29	2500	56.7
30-34	940	21.3
35	724	16.4
Education (years)		
6	127	2.9
7-12	2191	49.9
>12	2074	47.2
Mestizo ethnicity	3425	77.8
Married/living with a partner	3614	82.2
Employed	2084	47.3
Access to basic foods		
Hard	2063	46.9
Not very hard	2336	53.1
Nulliparous	2121	48.2
Planned pregnancy	1783	40.6
Gestational age at interview ^I	10.26 ± 3.76	
Early pregnancy BMI (kg/m ²)		
<18.5	87	2.0
18.5-24.9	2103	48.2
25-29.9	1624	37.2
30	551	12.6
Infant birth weight (grams) ^I	3374.0 ± 539.05	
Low birth weight (< 2500g)	214	4.9
Preterm birth (<37 weeks)	279	6.3
C-section delivery	1679	38.1
Gestational age at delivery (weeks) ^I	38.65 ± 1.85	
Infant size at birth		
SGA	176	4.0
AGA	3400	77.1
LGA	832	18.9

Abbreviations: BMI, body mass index; AGA, appropriate for gestational age; SGA, small for gestational age; LGA, large for gestational age

^I mean ± SD (standard deviation).

Table 2.

Associations between depression, generalized anxiety, and PTSD in early pregnancy with low birth weight (N = 4,408)

Psychiatric symptoms	Normal birth weight (≥ 2500g) N = 4,194	Low birth weight (< 2500g) N = 214	Unadjusted odds ratio (95% CI)	Adjusted odds ratio ^I (95% CI)
Depression				
No	3097	158	Reference	
Yes	1097	56	1.00 (0.73-1.37)	1.01 (0.74-1.39)
Generalized Anxiety				
No	2845	127	Reference	
Yes	1349	87	1.45 (1.09-1.91)	1.47 (1.10-1.95)
PTSD				
No	2761	128	Reference	
Yes	1433	86	1.30 (0.98-1.71)	1.26 (0.94-1.68)

^I Adjusted for maternal age (continuous), parity (multiparous vs. nulliparous), early pregnancy BMI (continuous), difficulty paying for the basics (hard vs. not very hard), and infant sex

Table 3.

Associations between depression, generalized anxiety, and PTSD in early pregnancy with birth weight (grams)
(N = 4,408)

Psychiatric symptoms	Unadjusted model			Adjusted model ^I		
	beta	p	95%CI	Beta	p	95%CI
Depression						
No			Reference			Reference
Yes	-23.43	0.205	(-59.64, 12.79)	-23.42	0.203	(-59.50, 12.67)
Generalized Anxiety						
No			Reference			Reference
Yes	-39.71	0.022	(-73.66, -5.76)	-46.32	0.007	(-80.26, -12.39)
PTSD						
No			Reference			Reference
Yes	-22.89	0.180	(-56.38, 10.60)	-18.14	0.289	(-51.66, 15.38)

^I Adjusted for maternal age (continuous), parity (multiparous vs. nulliparous), early pregnancy BMI (continuous), difficulty paying for the basics (hard vs. not very hard), and infant sex

Table 4.

Associations between depression, generalized anxiety, and PTSD in early pregnancy with preterm birth (N = 4,408)

Psychiatric symptoms	Term birth N=4,129	Preterm birth N=279	Unadjusted odds ratio (95% CI)	Adjusted odds ratio ^I (95% CI)
Depression				
No	3049	206	Reference	Reference
Yes	1080	73	1.0 (0.76-1.32)	1.02 (0.77-1.35)
Generalized Anxiety				
No	2797	175	Reference	Reference
Yes	1332	104	1.25 (0.97-1.60)	1.25 (0.97-1.62)
PTSD				
No	2722	167	Reference	Reference
Yes	1407	112	1.30 (1.01-1.66)	1.28 (1.00-1.65)

^I Adjusted for maternal age (continuous), parity (multiparous vs. nulliparous), early pregnancy BMI (continuous), difficulty paying for the basics (hard vs. not very hard), and infant sex

Table 5.

Associations between depression, generalized anxiety, and PTSD in early pregnancy with gestational age at delivery (weeks) (N = 4,408)

Psychiatric symptoms	Unadjusted model			Adjusted model ^I		
	beta	p	95%CI	beta	p	95%CI
Depression						
No			Reference			Reference
Yes	-0.03	0.624	(-0.16, 0.09)	-0.04	0.507	(-0.17, 0.08)
Generalized Anxiety						
No			Reference			Reference
Yes	-0.14	0.015	(-0.26, -0.03)	-0.15	0.010	(-0.27, -0.04)
PTSD						
No			Reference			Reference
Yes	-0.13	0.033	(-0.24, -0.01)	-0.13	0.029	(-0.25, -0.01)

^I Adjusted for maternal age (continuous), parity (multiparous vs. nulliparous), early pregnancy BMI (continuous), difficulty paying for the basics (hard vs. not very hard), and infant sex

Table 6.

Associations between depression, generalized anxiety, and PTSD in early pregnancy with size at birth (N = 4,408)

Psychiatric symptoms	AGA	SGA	LGA	Unadjusted odds ratio (95% CI)		Adjusted ^I odds ratio (95% CI)	
	N	N	N	SGA	LGA	SGA	LGA
Depression							
No	2497	134	624	Reference	Reference	Reference	Reference
Yes	903	42	208	0.87 (0.61-1.24)	0.92 (0.77-1.10)	0.87 (0.61-1.25)	0.94 (0.78-1.12)
Generalized Anxiety							
No	2305	107	560	Reference	Reference	Reference	Reference
Yes	1095	69	272	1.36 (1.00-1.85)	1.02 (0.87-1.20)	1.39 (1.01-1.92)	1.01 (0.86-1.20)
PTSD							
No	2230	116	543	Reference	Reference	Reference	Reference
Yes	1170	60	289	0.99 (0.72-1.36)	1.01 (0.87-1.19)	0.97 (0.70-1.35)	1.07 (0.91-1.26)

^I Adjusted for maternal age (continuous), parity (multiparous vs. nulliparous), early pregnancy BMI (continuous), difficulty paying for the basics (hard vs. not very hard), and infant sex

Abbreviations: AGA, appropriate for gestational age; SGA, small for gestational age; LGA, large for gestational age