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SHORT REPORT



# Association between diagnosed perinatal mood and anxiety disorders and adverse perinatal outcomes

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**ABSTRACT**

**Purpose:** To determine whether a diagnosis of a perinatal mood and anxiety disorder (PMAD) is associated with adverse perinatal outcomes.

**Methods:** Mental health symptom screening and diagnostic data from 82 women with single gestation in the Healthy Babies Before Birth study conducted from 2013 to 2018 were obtained by clinic interview. If a woman scored over 10 on the Patient Health Questionnaire (PHQ-9) or endorsed the suicidality item; or scored over 7 on the Overall Anxiety Severity and Impairment Scale (OASIS), a Structured Clinical Interview for DSM-IV (SCID) Axis I Disorders was administered. An adverse perinatal outcome was operationalized as a diagnosis of gestational diabetes mellitus, intrauterine growth restriction, preeclampsia, chorioamnionitis, hemorrhage, fetal death, preterm birth, or a low birthweight baby, and abstracted from the medical records.

**Results:** Women were between 22.0 and 45.0 years old (Mean age = 33.1 ± 4.3). Mean BMI was 24.7 ± 5.6 (Range 16.8 to 47.1). Nineteen percent (16) of the 82 women had a SCID diagnosis of a PMAD. Thirty-seven percent (30) had a diagnosed adverse perinatal outcome. Multiple logistic regression was conducted with these predictors: SCID diagnosis of a PMAD, maternal age, BMI. All predictors were significant with respective odds ratios as follows: OR = 3.58, 95% CI 1.03–12.44, $p = .045$; OR = 2.30, 95% CI 1.21–4.38, $p = .011$; OR = 1.69, 95% CI 1.06–2.69, $p = .027$.

**Conclusions:** A PMAD diagnosis was associated with 3.5 times higher odds of having an adverse perinatal outcome. For every 5 years a woman aged or every five units her BMI increased her odds of having an adverse perinatal outcome increased. Older age and increased BMI are well established adverse perinatal outcome risk factors. These results suggest that mental illness risk should also be consistently assessed in obstetric settings.

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Perinatal mood and anxiety disorders; prenatal depression; postpartum depression; adverse perinatal outcomes

## Introduction

Approximately 20% of women experience perinatal mood and anxiety disorders (PMADs), which encompass a range of mental health disorders that occur during pregnancy and up to one year postpartum [1–3]. Depression and anxiety during pregnancy have been associated with poor maternal health behaviors [4] and risk of postpartum depression. Postpartum depression occurs in 10% of mothers and has long-lasting implications for maternal well-being [5]. Indeed, suicide is in the same class as bleeding and high blood pressure as a leading cause of death during pregnancy and the first year postpartum [6]. PMADs have significant consequences for the mother, infant and family [7,8] and are heavily stigmatized and often overlooked. Fifty percent of all women with PMADs are never identified though they are treatable once identified [3].

Prenatal depression and anxiety are also associated with increased risk for adverse pregnancy outcomes (APO), including preterm birth (<37 weeks gestation) and low birth weight (<2500 g), affecting approximately 10% and 8.3% of US pregnancies, respectively [9,10]. These pregnancy outcomes are among the leading causes of neonatal death [11] and have long-term implications for child development [12]. They have also been associated with long-term mental illness [13,14] and are costly on a societal level, resulting

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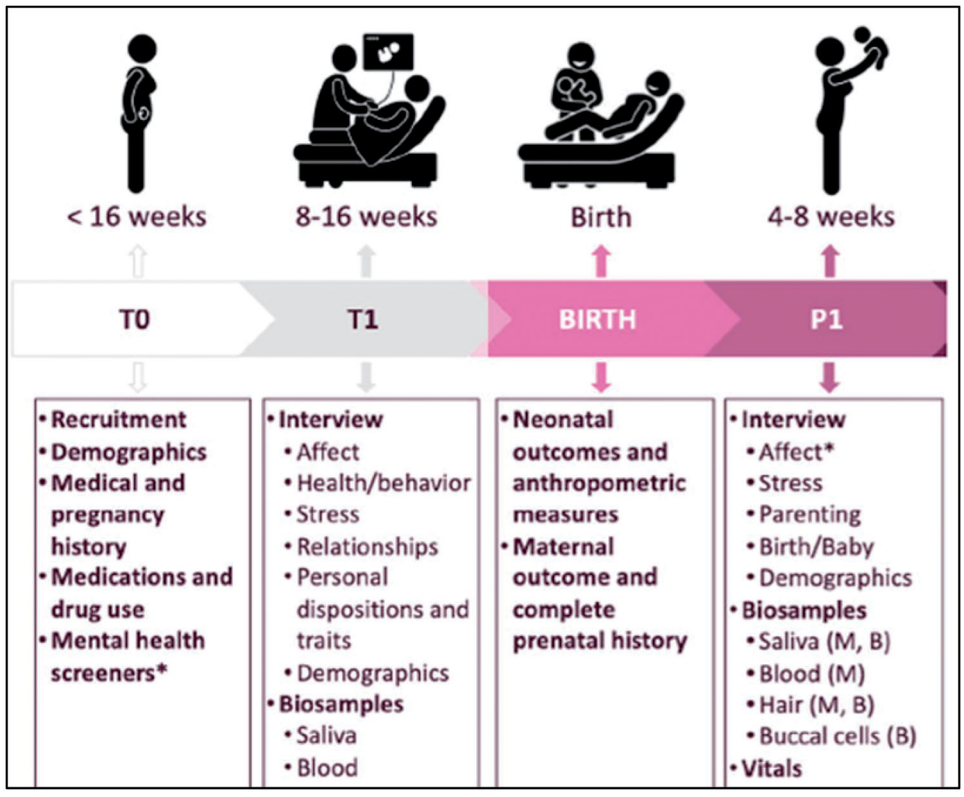


Figure 1. Study timeline.

in millions of dollars in healthcare costs and losses in earning potential [15]. Therefore, understanding the factors associated with risk for APO are a major research priority. The purpose of this study was to test whether a diagnosed PMAD is associated with APOs defined here as gestational diabetes mellitus, intrauterine growth restriction preeclampsia, chorioamnionitis, hemorrhage, fetal death, preterm birth, or a low birth weight baby. Previous research has used screening tools or medical record data on antidepressant use to identify women at-risk for PMADs. To our knowledge, this is one of the first studies to diagnose PMADs using the Structured Clinical Interview for DSM-V (SCID).

## Methods

### Participants

The present study includes demographic, mental health screening and diagnostic data from 82 women in the Healthy Babies Before Birth (HB3) study between 2013 and 2017 (Figure 1). Inclusion criteria were 18 years of age or older and singleton pregnancies up to 12 weeks gestation. Exclusion criteria were HIV-positive status, current smoking, substance abuse or medications that could affect inflammatory processes. Study data were collected and managed using REDCap electronic data capture tool [16].

### Procedures

Participants were recruited in clinics and private practices in a major urban medical center through direct patient contact and brochures (designated timepoint T0). Written informed consent was obtained. Upon enrollment, participants were screened for anxiety symptoms with the Overall Anxiety Severity and Impairment Scale (OASIS) and for depression symptoms with the Patient Health Questionnaire-9 (PHQ-9) [17,18]. If they scored greater than 10 on the PHQ-9 (excluding the item endorsing fatigue) or above 7 on the OASIS, then a trained Master's level clinical researcher conducted the Structured Clinical Interview for DSM-V (SCID) [19] to determine whether there was an Axis I mood or anxiety disorder diagnosis (designated timepoint T1). Efforts were made to overrecruit women with anxiety and depressive symptoms. For the current study, associations between PMAD diagnosis were examined using data from first trimester (T1) and 4–8 weeks postpartum (designated timepoint P1) visits.

**Table 1.** Demographic, medical and psychosocial data for the 82 women in the final sample dichotomized by Adverse Perinatal Outcome (APO) status.

| | APO + $N = 30$ (37%) | APO - $N = 52$ (63%) | *p*-value |
|---|---|---|---|
| Maternal Age | 34.53 ± 4.71 | 32.35 ± 3.95 | .027 |
| T1 BMI (kg/ $m^2$)[a] | 26.73 ± 7.23 | 24.18 ± 4.22 | .05 |
| P3 BMI ($kg/m^2$)[b] | 25.78 ± 7.13 | 23.23 ± 4.06 | .046 |
| Race | | | .330 |
| White | 22 (73%) | 39 (75%) | |
| Black | 4 (13%) | 2 (4%) | |
| Asian | 2 (7%) | 8 (15%) | |
| Multiracial | 2 (7%) | 3 (6%) | |
| Ethnicity - Hispanic[c] | 21 (70%) | 38 (73%) | .820 |
| Education | 17.2 ± 2.9 | 17.4 ± 2.3 | .650 |
| Parity = 0 | 22 (73%) | 31 (60%) | .530[d] |
| PHQ-9 total score | 5.10 ± 2.78 | 4.62 ± 3.61 | .530 |
| OASIS total score | 5.17 ± 3.59 | 3.13 ± 2.68 | .005 |
| SCID Diagnosis of PMAD | 9 (30%) | 7 (13%) | .086 |
| Mental Illness Diagnosis abstracted from chart[d] | 8 (29%) | 5 (10%) | .054 |
| History of Antidepressants abstracted from chart[e] | 2 (4%) | 5 (17%) | .096 |

[a]T1 BMI was measured between 8–16 weeks gestation, $N = 79$ total.
[b]P3 BMI was measured around 1 year postpartum. Only $N = 49/52$ had BMI data in the APO– category.
[c]Hispanic ethnicity was selected by some participants in addition to the racial designations therefore our total does not equal 100%.
[d]Mental Illness diagnoses included an anxiety disorder a depressive disorder or both. Current data were available for $N = 13$. Past diagnoses data were available for $N = 3$ and data were missing for $N = 66$ women.
[e]Antidepressant medication data were available for $N = 80$, data were missing for 2 women.
Wilcoxon Test P for Parity, all other variables calculated *via* T-tests or Chi Square.

### Measures

The PHQ-9 [18] is an instrument for screening, monitoring and measuring the severity of depression symptoms. The diagnostic validity of the PHQ-9 has been established in studies involving primary care and obstetrical clinics. In previous studies, scores of $\geq$10 had a sensitivity of 88% and a specificity of 88% for major depression.

The OASIS [17] is a 5-item measure that assesses frequency and severity of anxiety symptoms, behavioral avoidance and functional impairment. The OASIS instructions ask the patient to consider a variety of experiences such as panic attacks, worries and flashbacks and is therefore potentially applicable to any anxiety disorder.

### Outcome variables

Adverse perinatal outcome or APO diagnoses were abstracted from the medical record (timepoint designated Birth) and operationalized as one or more of these conditions: gestational diabetes mellitus, intrauterine growth restriction, preeclampsia, chorioamnionitis, hemorrhage, fetal death, preterm birth, or a low birth weight baby.

### Covariates

Maternal age and BMI were included as covariates and were collected at study entry. Height was measured at T1 (8–16 weeks gestation) and weight was calculated at T1 and P1 (4–8 weeks postpartum). BMI ($kg/m^2$) was calculated by taking weight (kg) and dividing by height squared ($m^2$).

### Analytic strategy

Multiple logistic regression models predicting APO diagnosis were performed with the following predictors: SCID diagnosis of a PMAD, age and BMI at two time points. Adjusted odds ratios (OR) and their 95% confidence intervals (CI) were reported. A two-sided 0.05 significance level was used throughout. SAS version 9.4 (SAS Institute, Cary, NC, USA) was used for statistical calculations.

## Results

Complete descriptive data for the sample of 82 women are in Table 1. Data were missing for 30 women on one or more key variables; APO, BMI, age and/or SCID diagnosis of a PMAD. Thus, we compared these variables in the 82 women in the sample to the 30 women and found no significant differences. Women in the final sample ranged from 22.0 to 45.0 years old ($M = 33.1 \pm 4.3$) and their BMI ranged from 16.8 to 47.1 ($M = 24.7 \pm 5.6$). Approximately 74% were White, 72% were Hispanic, 12% were Asian, 7% were Black, and 6% identified as mixed race. Approximately 65% were primiparous. Nineteen percent (16) had a current SCID diagnosis of a PMAD.

**Table 2.** Thirteen women had more than one adverse perinatal outcome.

| Participant | GDM | IUGR | PE | CHR | PTB | LBW | GA (wks) | BW (g) |
|---|---|---|---|---|---|---|---|---|
| 1 | | | YES | | YES | | 34 | 2730 |
| 2 | | YES | YES | | | | 39 | 2722 |
| 3 | YES | | | YES | | | 38 | 2920 |
| 4 | YES | YES | | | | | 40 | 3031 |
| 5 | YES | | YES | | | | 39 | 3615 |
| 6 | | YES | | | YES | YES | 32 | 1086 |
| 7 | YES | | YES | | | | 38 | 3785 |
| 8 | | YES | | YES | | | 42 | 3025 |
| 9 | | YES | YES | YES | | | 41 | 3030 |
| 10 | | | YES | YES | | | 39 | 3010 |
| 11 | | YES | | YES | | | 38 | 2645 |
| 12 | | YES | YES | YES | | YES | 37 | 1845 |
| 13 | | | YES | YES | | | 39 | 4085 |

BW: Birth weight; CHR: chorioamnionitis; GA: gestational age; GDM: gestational diabetes mellitus; IUGR: intrauterine growth restriction; LBW: low birth weight; PE: preeclampsia; PTB: preterm birth.

Nine were diagnosed at T0 and the other seven individuals were diagnosed at P1. To compare to methods of previous studies, medical records were reviewed for mental illness diagnoses. Thirteen women had a diagnosis of a depressive disorder, anxiety disorder or both, abstracted from the medical record. It is unclear whether these are current diagnoses; however, three women were not included in the 13 since the labels, "past," "history of" and "in college" were included in the medical record (Table 1). Thirty of the 82 women had one or more APO (37%) and 13 of the 30 women had 2 or more APO (43%), (Table 2).

Multiple logistic regression results showed that all three predictors were associated with APO; PMAD diagnosis OR 3.58, 95% CI 1.03–12.44, $p = .045$; Age (for an increase of 5 years) OR 2.30, 95% CI 1.21–4.38, $p = .011$; postpartum BMI (for an increase of 5 units) OR 1.69, 95% CI 1.06–2.69, $p = .027$. When re-analyzed using prenatal BMI measured at T1, results remained significant for all three predictor variables; PMAD diagnosis OR 3.59, 95% CI 1.00–12.87, $p = .049$; Age OR 2.41, 95% CI 1.24–4.67, $p = .009$; BMI at T1 OR 1.76, 95% CI 1.08–2.87, $p = .024$. Women with a SCID diagnosis of a PMAD had 3.58 times the odds of developing an adverse outcome compared to those without a SCID diagnosis of a PMAD. A five-year increase in age was associated with 2.30 times the odds of an adverse outcome (130% increase in the odds of an APO). A five unit increase in BMI was associated with 1.69 times the odds of an adverse outcome (69% increase).

## Discussion

Older age and increased BMI are well-established risk factors for perinatal adversities and are always assessed clinically. These results suggest that PMAD risk should also be consistently assessed clinically in obstetric settings. Ideally, women would be identified and connected to mental health care as early as possible to minimize the negative emotional and physiological effects of the disease [1]. These findings are in line with much of the extant literature, although there are some notable differences. Specifically, Boukakiou et al. reported that an episode of mental illness during pregnancy was linked to low birth weight and NICU hospitalizations in 1439 mother–baby pairs. Their population included women hospitalized with severe mental illnesses [20]. Our sample is more generalizable to the birthing population. McKee and colleagues reported that from 39,025,974 deliveries, the incidence of preterm birth was higher among women with PMAD and serious mental illness compared to those without either condition [21]. Women with PMADs also had higher mean delivery-related costs. Both of these studies used medical record data to identify women with PMAD [20,21].

### *Strengths, limitations and future directions*

The main strength of the present study was that that PMAD diagnoses were obtained using structured diagnostic interviews, as opposed to screening tools or medical record data on antidepressant use, which provides higher confidence that women currently met criteria for the disorders. Interestingly we were able to compare our real-time diagnosis (no missing data) with mental illness diagnosis data abstracted from the medical record. Only nine of the 13 women with medical record diagnoses met criteria for a mood or anxiety disorder in the perinatal period (based on our SCID diagnosis of PMAD). Therefore, the strength of our study is clearly the confirmation of current disease that one cannot conclude from the medical record. Our population was small and only somewhat racially diverse and did not smoke or abuse drugs and alcohol, unlike prior studies where women were hospitalized, and/or had more severe symptoms, higher levels of medication and tobacco and alcohol use that could complicate results. Future work will focus on the inflammatory mechanisms involved as well as associations with future cardiovascular disease. Findings highlight the increasing importance of addressing perinatal mental health conditions to prevent adverse obstetric outcomes.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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