

# Psyche: The 5th 'P' and its Associated Impact on the Second Stage of Labor

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## ABSTRACT

**OBJECTIVE:** Patients with depression during labor display dysregulated patterns of oxytocin release and this may impact second stage of labor. The objective of this study was to evaluate the association between maternal preconception and antenatal depressive disorders on the duration of second stage of labor and perinatal outcomes.

**STUDY DESIGN:** Secondary analysis of patients enrolled in the Behavioral and Mood in Mothers, Behavior in Infants study who reached the second stage of labor. Participants were assigned to: pre-conception only major depressive disorder (MDD), prenatal major depressive disorder, and non-depressed controls. Primary outcome was prolonged second stage of labor. Secondary outcomes included perinatal morbidities.

**RESULTS:** 172 patients were included. 24.4% (42/172) participants had preconception-only MDD, 42.4% (73/172) patients had prenatal MDD, and 33.1% (57/172) patients had as non-depressed controls. The adjusted pair-wise analysis between groups showed no significant difference in the duration of second stage. No statistically significant differences were noted between groups for adverse neonatal outcomes.

**CONCLUSION:** Maternal depressive disorders did not impact length of second stage of labor or immediate perinatal outcomes.

**KEYWORDS:** depression; anxiety; labor; psyche

## INTRODUCTION

The adage of the "Four P's" of labor has been described for decades. The "P's" are defined as power (strength of contractions/pushing), passage (shape of maternal pelvis), passenger (size of fetus) and position (of the fetus with respect to the pelvis).<sup>1</sup> Although there are many other factors that contribute to the outcome of the second stage of labor, such as maternal height, age, parity, presence of diabetes, epidural anesthesia, and fetal position, the four "P's" remain clinically important and relevant to the success and/or length of the second stage of labor.<sup>2,3</sup>

There has been consideration of a "5th P," defined as "psyche," which reflects the psychologic state of the parturient.<sup>1</sup> Maternal psychiatric disorders are commonly encountered

during pregnancy, with an incidence of depression in approximately 12% of pregnancies.<sup>4</sup> Depression in pregnancy is associated with poor perinatal outcomes including preterm birth, fetal growth restriction (FGR), and low birth weight.<sup>5-8</sup> In addition, maternal depression frequently co-occurs with other factors that are linked to adverse pregnancy outcomes, such as smoking, substance abuse, hypertension, and diabetes.<sup>7</sup>

Previous studies have shown an association between maternal anxiety and catecholamine levels which result in a longer duration of labor.<sup>9,10</sup> Interestingly, maternal anxiety has been proposed to have developed as an evolutionary advantage to early humans, who had to evade predators in order to survive.<sup>11</sup> Anxiety could have represented a response that prioritized survival. Additionally, there is some evidence that patients with depression during labor display dysregulated patterns of oxytocin release, which suggests that maternal "psyche" may have a biologically plausible impact on dysfunctional labor.<sup>12</sup>

Maternal depression has the potential to play a role in second stage of labor duration and could influence maternal pushing ability. Prior studies of the second stage of labor, have yielded inconsistent data regarding the optimal time to intervene by operative vaginal birth or cesarean birth during prolonged second stage labor.<sup>13,14</sup> Prolonged second stage of labor has been associated with maternal complications such as chorioamnionitis and obstetric anal sphincter injury, and neonatal outcomes are mixed after a prolonged second stage of labor.<sup>15-17</sup> There is limited evidence investigating links between maternal depressive disorders and the duration of the 2nd stage of labor despite known complications related to a prolonged 2nd stage of labor. It is important to understand the relationship between depression and the duration of the second stage as depression could potentially contribute to increased maternal and neonatal morbidity during labor.

Thus, we wanted to examine a potential association between patients with preconception only or pregnancy associated major depressive disorder (MDD) on the outcomes of the second stage of labor. We hypothesized that maternal depression would influence maternal pushing ability and therefore increase the length of the second stage of labor. The objective of this study was to evaluate the effect of preconception and prenatal MDD on the duration of the second stage of labor. Secondary outcomes regarding maternal and neonatal outcomes related to the second stage of labor were also evaluated.

## MATERIALS AND METHODS

This is a secondary analysis of women enrolled in the Behavioral and Mood in Mothers, Behavior in Infants (BAMBI) study, which was performed between March 2008 and January 2013 in Rhode Island. The BAMBI study was a prospective study over-sampled for women with prenatal and preconception MDD examining several behavioral and biochemical outcomes in pregnant women and their infants.<sup>18</sup> For this analysis, we included patients with non-anomalous, singleton gestations in cephalic presentation who reached the second stage of labor.

Patients were assigned to one of three groups: preconception-only MDD, prenatal MDD, and non-depressed control. The preconception MDD group included women with a history of one or more lifetime major or minor depressive episodes before the current pregnancy and conception window. The prenatal MDD group included women who met criteria for major or minor depressive episode at any time during the current pregnancy or within three months of conception. Patients in the prenatal MDD group included those with and without episodes of lifetime preconception MDD. Control patients were free of lifetime and current mood disorder diagnoses.

Participants completed up to three interviews between 18 and 39 weeks of pregnancy, and immediately post-birth interview on postpartum day one or two, and an interview at one month postpartum. Evaluation for prenatal MDD included the 3<sup>rd</sup> trimester and immediate postpartum period during the birthing hospitalization. At the first interview, patients completed the mood, anxiety and psychotic screen modules of the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) Axis I Disorders-Research Version, Non-patient Edition.<sup>19</sup> Major depressive episodes were based on DSM-IV criteria; minor depressive episodes were based on DSM-IV appendix B criteria. Patients reported on lifetime and current mood disorders during the first interview. At each subsequent interview, the Structured Clinical Interview for DSM-IV current mood disorders module was administered to assess for major/minor depressive episodes since the prior assessment.

Patients also completed the Inventory of Depressive Symptomatology-Self-Rated (IDS-SR) at each prenatal interview, which included four-point Likert ratings of 21 depressive symptoms over the previous week.<sup>20</sup> This study converted IDS scores into Quick Inventory of Depression Symptomatology (QIDS) scores to quantify the level of depression, since the QIDS scores incorporate the specific areas (mood, interest/pleasure in activities, weight/appetite, sleep, psychomotor agitation/retardation, fatigue, self-criticism, concentration, thoughts of death/suicide) used to categorize depressive disorders in the DSM-IV.<sup>19</sup> QIDS was designed to measure overall severity of the MDD by assessing each of the nine symptom domains that define the syndrome.

The IDS assesses the same nine domains and other commonly associated symptoms (e.g., anxiety, irritability). The total QIDS scoring system ranges from 0 to 27 to quantify the degree of depression; a score of less than 5 indicates no depression, 6 to 10 signifies mild depression, 11 to 15 is moderate depression, 16 to 20 is consistent with severe depression, and a score greater than 20 is concerning for very severe depression.

In addition, Hamilton Anxiety Rating Scale (HAM-A) total scores were utilized to quantify the level of anxiety in study patients.<sup>21</sup> This scale uses 14 items that are scaled from 0 to 4 to quantify the level of anxiety; a score less than 17 is characterized as mild anxiety, 18 to 24 is mild/moderate anxiety, and a score greater than 24 represents severe anxiety.

The primary outcome was prolonged second stage of labor. The American College of Obstetricians and Gynecologists (ACOG) define a prolonged second stage of labor as greater than 2 hours in multiparous patients (3 hours with epidural anesthesia) and 3 hours in primiparous patients (4 hours with epidural anesthesia).<sup>22</sup> The definition used for prolonged second stage of labor in this study was greater than three hours, given that the patients included in the study were a combination of nulliparas and multiparas, with mixed usage of epidural anesthesia and because the BAMBI data was collected prior to 2014 and before new guidelines were implemented.

Maternal secondary outcomes included mode of birth, presence of shoulder dystocia, indication for cesarean birth (CB) (if applicable), duration of second stage of labor, rupture of membrane (ROM) type, i.e., spontaneous or artificial, and social services utilization. In addition, QIDS and HAM-A scores from maternal interviews were examined in the prenatal MDD group to evaluate if timing of diagnosis of prenatal MDD during pregnancy was associated with a prolonged second stage of labor. Neonatal outcomes included birthweight, growth percentile, small for gestational age categorization, presence of meconium during birth, jaundice, special care admission, and neonatal intensive care unit (NICU) admission.

Univariate assessments of all variables were examined. Bivariable comparisons between the preconception MDD and prenatal MDD were performed using Wilcoxon rank-sum for continuous variables. The Kruskal-Wallis test was used for comparisons between the three groups. Categorical variables were compared using Fisher's exact test. Simple and multivariable linear regression models were used to examine the association between depression study groups and duration of 2<sup>nd</sup> stage. Duration of the second stage of labor was log-transformed in order to approximate normal distribution. Statistical analysis was performed using Stata/SE 15.1 (College Station, TX).

The institutional review board at Women and Infants Hospital considered this study exempt since this was a secondary analysis using de-identified data set.

## RESULTS

A total of 172 patients were included for analysis. 42 patients were characterized as having preconception only MDD (42/172, 24.4%), 73 patients were categorized as having prenatal MDD, (73/172, 42.4%) and 57 patients 33.1% (57/172, 33.1%) patients were classified as the control group. The demographic data of included patients were significantly different for maternal age, parity, race, insurance type (Table 1). The preconception only MDD group included 57.1% (25/41) nulliparas and 80.5% (33/41) utilized epidural anesthesia. The prenatal MDD group included 47.9% (34/69) nulliparas and 76.8% (53/69) utilized epidural anesthesia. Lastly, the control group included 70.2% (40/55) nulliparas and 81.8% (45/55) utilized epidural anesthesia.

The second stage of labor was prolonged in 13.8% (4/29) of the preconception MDD group, in 8.3% (4/48) of the prenatal MDD group, and 10.0% (4/40) of the control group ( $p = 0.69$ ). The average duration of the second stage of labor was 64.0, 56.6, and 81.7 minutes for the preconception MDD, prenatal MDD, and control groups, respectively ( $p = 0.08$ ). Maternal outcomes are seen in Table 2. 75.6% (31/41) of patients delivered vaginally in the preconception MDD group, 85.9% (61/71) delivered vaginally in the prenatal MDD group, and 81.8% (45/55) delivered vaginally in the control group ( $p = 0.38$ ). There was a statistically significant difference between the groups with regards to number of CB's due to arrest of descent. Of the patients that delivered via CB in the second stage of labor, arrest of descent was the indication for 10% of the preconception MDD group (1/10), 60% of the prenatal MDD group (6/10), and 70% of the control group (7/10) ( $p = 0.02$ ). In addition, there was a statistically significant difference in the utility of hospital social services, which was more common in the prenatal MDD group at 68.6% ( $n=70$ ) in comparison to the preconception

**Table 1.** Demographic Data of included subjects

	Preconception only major depression disorder (n=42)	Prenatal major depression disorder (n=73)	Control (n=57)	p-value
Maternal age, Mean (SD)	28.0 (4.9)	25.4 (5.4)	25.8 (5.7)	0.02 <sup>a</sup>
Gestational age at birth, Mean (SD)	39.8 (1.0)	39.7 (1.0)	39.9 (0.96)	0.64 <sup>a</sup>
Pre-pregnancy BMI (kg/m <sup>2</sup> ) Mean (SD)	26.9 (7.1)	26.3 (7.5)	23.9 (3.8)	0.11 <sup>a</sup>
Parity, Median (Min-Max)	0 (0-4)	1 (0-6)	0 (0-5)	0.03 <sup>a</sup>
Race				
AI/AN	1 (2.4)	0 (—)	1 (1.8)	0.02 <sup>a</sup>
Asian	2 (4.8)	2 (2.8)	4 (7.0)	
NH/PI	0 (—)	1 (1.4)	0 (—)	
Black	2 (4.8)	15 (20.8)	10 (17.5)	
White	30 (71.4)	26 (36.1)	28 (49.1)	
Multiracial	3 (7.1)	9 (12.5)	4 (7.0)	
Unknown	4 (9.5)	19 (26.4)	10 (17.5)	
Ethnicity				
Hispanic/Latino	8 (19.1)	27 (38.0)	14 (24.6)	0.33 <sup>a</sup>
Portuguese	1 (2.4)	2 (2.8)	3 (5.3)	
Cape Verdean	1 (2.4)	4 (5.6)	1 (1.8)	
Not Hispanic/Latino	30 (71.4)	33 (46.5)	32 (56.1)	
Other	2 (4.8)	4 (5.6)	5 (8.8)	
Unknown	0 (—)	1 (1.4)	2 (3.5)	
Insurance type				
Public	16 (40.0)	52 (77.6)	29 (52.7)	<0.001 <sup>a</sup>
Private	24 (60.0)	14 (20.9)	25 (45.5)	
Both public and private	0 (—)	1 (1.5)	1 (1.8)	
3rd Trimester Depression Symptoms <sup>e</sup>				
Mean (SD)	4.4 (3.3)	7.2 (4.3)	2.9 (2.5)	<0.01 <sup>a</sup>
Median (Min-Max)	4 (0-12)	7 (0-19)	3 (0-9)	
IQR (Q1-Q3)	(2-6)	(4-10)	(0-4)	
3rd Trimester Anxiety Symptoms <sup>f</sup>				
Mean (SD)	8.1 (6.3)	10.1 (4.9)	4.8 (3.5)	<0.01 <sup>a</sup>
Median (Min-Max)	7 (0-28)	10 (0-23)	4 (0-15)	
IQR (Q1-Q3)	(4-12)	(7-13)	(2-7)	
Antidepressant use	1 (2.4)	7 (9.6)	1 (1.8)	0.13 <sup>b</sup>
Epidural	33 (80.5)	53 (76.8)	45 (81.8)	0.81 <sup>b</sup>
Induction	12 (29.3)	20 (28.6)	21 (38.2)	0.51 <sup>b</sup>
Oxytocin	25 (59.5)	34 (46.6)	35 (61.4)	0.19 <sup>b</sup>

Categorical data are N(%)

<sup>a</sup> Kruskal-Wallis

<sup>b</sup> Fisher's exact test

<sup>c</sup> Depression at delivery: QIDS score immediately post partum

<sup>d</sup> Anxiety symptoms at delivery- HAM-A score

<sup>e</sup> 3rd Trimester Depression- QIDS score 3rd trimester

<sup>f</sup> 3rd Trimester Anxiety- HAM-A score 3rd trimester

Note: The total QIDS scoring system ranges from 0 to 27 to quantify the degree of depression; a score of less than 5 indicates no depression, 6 to 10 signifies mild depression, 11 to 15 is moderate depression, 16 to 20 is consistent with severe depression, and a score greater than 20 is concerning for very severe depression. In addition, Hamilton Anxiety Rating Scale (HAM-A) total scores were utilized to quantify the level of anxiety in study patients.<sup>23</sup> This scale uses 14 items that are scaled from 0 to 4 to quantify the level of anxiety; a score less than 17 is characterized as mild anxiety, 18 to 24 is mild/moderate anxiety, and a score greater than 24 represents severe anxiety

Total n for each variable range from 69-73 for prenatal depression, 38-42 for preconception depression and 55-57 for control.

Abbreviations: SD- standard deviation, Min- minimum, Max- maximum, IQR- interquartile range, BMI- body mass index, AI/AN- American Indian / Alaska Native, NH/PI- Native Hawaiian / Pacific Islander

**Table 2.** Maternal Outcomes by Classification of Maternal Depression

	Preconception only major depression disorder (n=42)	Prenatal major depression disorder (n=73)	Control (n=57)	p-value
Prolonged 2nd stage (>3hrs)	4 (13.8)	4 (8.3)	4 (10.0)	0.69a
Spontaneous vaginal birth	31 (75.6)	61 (85.9)	45 (81.8)	0.38a
Cesarean birth	10 (24.4)	10 (14.1)	10 (18.2)	0.38a
Forceps assisted	0 (—)	2 (3.4)	0 (—)	0.50a
Vacuum assisted	0 (—)	5 (8.5)	2 (4.4)	0.28a
Shoulder dystocia	1 (3.2)	2 (3.4)	0 (—)	0.46a
Indication for CB				
Elective	0 (—)	2 (20.0)	1 (10.0)	0.75a
Nonreassuring fetal status	6 (60.0)	6 (60.0)	6 (60.0)	1.00a
Arrest of descent	1 (10.0)	6 (60.0)	7 (70.0)	0.02a
Total time of 2nd stage (minutes)				
Mean (SD)	64.0 (87.0)	56.6 (71.9)	81.7 (86.7)	0.08a
Median (Min-Max)	23.0 (7.0–349.9)	23.0 (2.0–330.0)	49.0 (9.0–397.0)	
Rupture of membranes type				
Spontaneous	13 (32.5)	28 (40.6)	24 (43.6)	0.93a
Assisted	20 (50.0)	30 (43.5)	25 (45.5)	
Unknown	6 (15.0)	9 (13.0)	5 (9.1)	
C-section	1 (2.5)	2 (2.9)	1 (1.8)	
Hospital social services	15 (36.6)	48 (68.6)	17 (30.9)	<0.001a

Categorical data are N(%)

aFisher's exact test

Total n for each variable ranges from 10–73 for prenatal depression, 10–42 for preconception depression and 10–57 for control.

Abbreviations: CB-Cesarean birth, SD-standard deviation, Min-minimum, Max-maximum

**Table 3.** Crude and Adjusted Linear Regression Models for Duration of Second Stage of Labor<sup>1</sup>

Depression study group	$\beta$ coefficient (95% CI)	p-value	Adjusted $\beta$ (95% CI) <sup>2</sup>	p-value
Control	Referent	Referent	Referent	Referent
Preconception only major depression disorder	-0.45 (-0.99, 0.08)	0.09	-0.44 (-0.98, 0.11)	0.11
Prenatal major depression disorder	0.53 (-1.01, -0.06)	0.03	-0.26 (-0.75, 0.22)	0.28

<sup>1</sup>Duration of 2nd stage log-transformed to approximate normal distribution

<sup>2</sup>Adjusted for age, race, gravidity, parity and insurance type

MDD (36.6% (15/41)) and control groups (30.9% (17/55)) ( $p < 0.001$ ).

Pair-wise analysis between groups (preconception-only MDD versus control, prenatal MDD versus control and preconception-only MDD versus prenatal MDD) showed no significant difference in the duration of the second stage of labor between any of the groups after adjustment for confounders.

When linear regression was utilized to compare the three groups to the log-transformed duration of the second stage of labor, the preconception-only MDD group was noted to have a shorter duration of the second stage of labor compared to the control group; however, after adjusting for confounders, no statistically significant difference was noted (Table 3).

When we evaluated the data to determine if timing of depression or anxiety (3rd trimester versus during the delivery hospitalization) impacted the length of second stage,

there was no difference in length of second stage of labor (Table 5).

Neonatal outcomes are shown in Table 4. No statistically significant differences were noted between the groups. The mean birth weight was 3458 grams in the preconception MDD group, 3356 grams in the prenatal MDD group, and 3420 grams in the control group ( $p = 0.47$ ). NICU admission 4.9% (2/41) in the preconception MDD group, was 2.9% (2/70) in the prenatal MDD group, and 12.7% (7/55) in the control group, ( $p = 0.09$ ).

The QIDS and HAM-A scores did not differ in women with MDD between the third trimester and postpartum period for women with prolonged second stage of labor or normal second stage of labor. The QIDS and HAM-A scores were similar for women with MDD regardless of length of the second stage of labor (Table 5).

**Table 4.** Neonatal Outcomes by Classification of Maternal Depression

	Preconception only major depression disorder (n=42)	Prenatal major depression disorder (n=73)	Control (n=57)	p-value
Birthweight (grams) Mean (SD)	3458 (415)	3356 (463)	3420 (409)	0.47 <sup>a</sup>
Growth percentile Mean (SD)	49 (25.9)	44.1 (27.1)	45.8 (24.3)	0.62 <sup>a</sup>
SGA (<10%)	1 (2.5)	1 (1.6)	2 (3.6)	0.15 <sup>b</sup>
Oxygen	5 (12.2)	7 (10.1)	8 (14.6)	0.76 <sup>b</sup>
Intubation	2 (4.9)	3 (4.4)	2 (3.6)	1.00 <sup>b</sup>
Delee suction	6 (14.6)	6 (8.7)	3 (5.5)	0.31 <sup>b</sup>
Chest physiotherapy	1 (2.4)	1 (1.5)	1 (1.8)	1.00 <sup>b</sup>
Meconium during birth	6 (14.6)	19 (27.5)	13 (23.6)	0.29 <sup>b</sup>
Special care admission	1 (2.4)	1 (1.4)	1 (1.8)	1.00 <sup>b</sup>
NICU admission	2 (4.9)	2 (2.9)	7 (12.7)	0.09 <sup>b</sup>
NICU length of stay (hours) Mean (SD)	(n=2) 85.3 (117.0)	(n=2) 19.0 (24.0)	(n=7) 108.7 (66.0)	0.13 <sup>a</sup>
Jaundice	35 (85.4)	55 (79.7)	46 (83.6)	0.76 <sup>b</sup>

Categorical data are N (%)

<sup>a</sup> Kruskal-Wallis

<sup>b</sup> Fisher's exact test

Total n for each variable were 55 for prenatal depression, 69-70 for preconception depression and 40-41 for control unless otherwise noted.

Abbreviations: SD-standard deviation, Min-minimum, Max-maximum, IQR-interquartile range, SGA-small for gestational age, NICU-Neonatal intensive care unit

**Table 5.** Prolonged Second Stage of Labor based on Timing of Maternal Depression during Pregnancy

	No prolonged 2nd stage (n=107)	Prolonged 2nd stage (n=13)	p-value <sup>a</sup>
Depression at delivery <sup>b</sup>			
Mean (SD)	4.6 (3.5)	3.9 (2.8)	0.75
Median (Min-Max)	4 (0-14)	4 (0-8)	
IQR (Q1-Q3)	(2-6)	(1-6)	
Anxiety symptoms at delivery <sup>c</sup>			
Mean (SD)	5.9 (4.6)	5.4 (2.2)	0.93
Median (Min-Max)	5 (0-21)	5 (2-9)	
IQR (Q1-Q3)	(3-9)	(3-7)	
3rd Trimester Depression <sup>d</sup>			
Mean (SD)	5.2 (4.1)	3.9 (2.9)	0.39
Median (Min-Max)	4 (0-19)	4 (0-9)	
IQR (Q1-Q3)	(2-7)	(2-6)	
3rd Trimester Anxiety <sup>e</sup>			
Mean (SD)	7.9 (5.4)	6.7 (4.4)	0.66
Median (Min-Max)	7 (0-28)	7 (1-15)	
IQR (Q1-Q3)	(4-10)	(2-10)	

<sup>a</sup>Wilcoxon rank-sum

Total n for each variable range from 10-73 for prenatal depression, 10-42 for preconception depression and 10-57 for control.

<sup>b</sup> Depression at delivery- QIDS score immediately post partum

<sup>c</sup> Anxiety symptoms at delivery- HAM-A score

<sup>d</sup> 3rd Trimester Depression- QIDS score 3rd trimester

<sup>e</sup> 3rd Trimester Anxiety- HAM-A score 3rd trimester

Note: The total QIDS scoring system ranges from 0 to 27 to quantify the degree of depression; a score of less than 5 indicates no depression, 6 to 10 signifies mild depression, 11 to 15 is moderate depression, 16 to 20 is consistent with severe depression, and a score greater than 20 is concerning for very severe depression. In addition, Hamilton Anxiety Rating Scale (HAM-A) total scores were utilized to quantify the level of anxiety in study patients.<sup>23</sup> This scale uses 14 items that are scaled from 0 to 4 to quantify the level of anxiety; a score less than 17 is characterized as mild anxiety, 18 to 24 is mild/moderate anxiety, and a score greater than 24 represents severe anxiety. Total n for each variable range from 69-73 for prenatal depression, 38-42 for preconception depression and 55-57 for control.

Abbreviations: SD- standard deviation, Min- minimum, Max- maximum, IQR- interquartile range



## DISCUSSION

### Principal Findings

This study showed no association between maternal preconception MDD or maternal prenatal MDD and the duration of the second stage of labor. There was an increase in CB performed for arrest of descent in the prenatal MDD and control groups compared to the preconception only MDD group, as well as an increase in hospital social services utilization in the prenatal MDD group. There were no statistically significant differences in neonatal outcomes. In addition, analysis of continuous depression and anxiety levels showed that there was no association between depression and anxiety severity during 3rd trimester or at delivery and the presence of a prolonged second stage of labor. The results of this study suggest that the fifth “P” for maternal psyche – at least in terms of depression – may not be connected with clinically measurable outcomes in relation to the second stage of labor.

### Results

There are limited studies in the literature which examine an association between maternal preconception or maternal prenatal MDD and the length of the second stage of labor. While one prior study showed that women with depression have more dysregulated patterns of oxytocin release when assigned with tasks that stimulate oxytocin release, thus one could infer a potential effect of depression on oxytocin release during labor, this study was not performed in a labor setting.<sup>12</sup> Oxytocin regulation is also likely more important in the first stage of labor compared with the second stage.

Several studies by Lederman et al. show a correlation between maternal anxiety and catecholamine levels, leading to an association with a longer duration of the first stage of labor. These studies examined patient anxiety through subjective reports as well as from objective observations by medical/nursing staff, which may have decreased external validity. In addition, these studies exclusively analyzed the first stage of labor.<sup>9,10</sup>

### Clinical implications

Although there was no significant difference in the second stage of labor duration between the groups, there were more CB's performed due to arrest of descent in the control group (70%, 7/10) and the prenatal MDD group (60%, 6/10), compared to the preconception-only MDD group (10%, 1/10) ( $p = 0.02$ ). This finding is likely related to the small number of patients included in this study. Post-hoc analyses are limited to the dataset that is used, and so it is unclear if other factors may have played a role in these second stage CB's, especially since non-reassuring fetal status also played a role in the control group (60%, 6/10), the prenatal MDD group (60%, 6/10), and the preconception MDD group (60%, 6/10). There could certainly be overlap in indications for mode of delivery, with some patients having multiple indications for CB. In addition, it is unclear whether other interventions were

considered, such as manual rotation, operative vaginal birth, or allowing more time in the second stage. Neonatal outcomes were similar in all three groups, which is consistent with a previous study that demonstrated no adverse neonatal outcomes in pregnancies with a prolonged second stage of labor.<sup>23</sup> QIDS scores and HAM-A were similar between women with prolonged second stage and women with a normal second stage, however the small sample size of the prolonged second stage group could have influenced these results and so further studies to examine these relationships are needed.

The protocol of the BAMBI study specifically differentiated between preconception and prenatal MDD in order to elucidate the connection of prenatal and preconception MDD on programming of fetal hypothalamic-pituitary-adrenal (HPA) axis regulation.<sup>18</sup> This is important because patients with preconception MDD could have confounders such as hormonal alterations from previous lifetime episodes of depression or a possible genetic predisposition to depression. Therefore, the BAMBI study was able to specifically examine the impact of prenatal MDD. The results demonstrated that in some patients, prenatal MDD showed more significant fetal glucocorticoid regulation than in preconception MDD or controls. This design allowed our secondary analysis to specifically differentiate between the effects of preconception-only and prenatal MDD on the duration of the second stage of labor.

### Research implications

This information is important and may play a role in labor management of patients with MDD. The BAMBI study showed that women with prenatal MDD, in comparison to women with preconception MDD had an increased impact on fetal HPA axis, which could alter long term health and behavioral outcomes in these infants.<sup>18</sup> Given the prevalence of maternal depression and the impact that it has on other pregnancy outcomes, future studies are required to further elucidate the impact of preconception and prenatal MDD on other aspects of labor. Additionally, studies are needed to explore the need for oxytocin dose and duration as well. Furthermore, given that this was performed in a small population of mixed parity and mixed use of labor analgesia, it will be important to confirm in a larger study focusing on nulliparous patients, where an established threshold for prolonged second stage can be utilized.

### Strengths and limitations

The major strength of our study is the design of the original protocol which included the utility of specific DSM criteria, depression and anxiety severity scores, therefore incorporating standardized assessments that provided validated and objective data. Since our study is one of the first in the literature to examine the link between preconception and prenatal MDD on the duration of the second stage of labor,

the utilization of these standardized assessments improves the replicability of this study and may establish preliminary data for future studies to further examine the connection between maternal depression and labor.

Limitations to this study include that the baseline characteristics differed between the groups such as age, parity, insurance type and history of panic disorder or post-traumatic stress disorder. While these variables were adjusted for in multivariable analysis, omitted-variable bias may still exist. In addition, prolonged second stage was defined as duration of greater than 3 hours due to the small number of patients in the sample size and due to the fact that data collected for the original BAMBI study was prior to 2014 and before new guidelines were implemented. Therefore, our results did not account for the possible confounding effects of parity and epidural anesthesia, which may have been significant.<sup>24</sup> Another limitation with this data set, as with all post-hoc analyses on labor, is the difficulty in accurately measuring the duration of the second stage of labor, since the second stage is not documented until a vaginal exam shows complete dilation, and the true second stage of labor duration is frequently underestimated. Lastly, the authors acknowledge the limitation regarding granularity of oxytocin use and dose during participants labor course as well as the moderate sample size.

## CONCLUSIONS

There was no association noted between preconception or prenatal MDD during pregnancy and prolonged duration of the second stage of labor in this cohort. Further research is needed to determine if maternal depression impacts other aspects of labor.

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