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## Risk factors for Postpartum Depressive Symptoms in Low-Income Women with Very Low Birth Weight Infants

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Approximately 19% of postpartum women experience a major depressive episode within three months of giving birth.<sup>1</sup> Up to 48% of low-income mothers report elevated postpartum depression symptoms.<sup>2</sup> Mothers with elevated postpartum depressive symptoms are those that score above an established cut off on self-report depression screening scales. Mothers with elevated postpartum depressive symptoms are less responsive and engage in fewer social behaviors toward their infants, resulting in fewer mother-infant interactions.<sup>3</sup> Elevated postpartum depressive symptoms have been linked with infant failure to thrive,<sup>4,5</sup> increased risk for developmental delays,<sup>6</sup> and difficulty with social interactions.<sup>7</sup>

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The incidence of postpartum depressive symptoms is higher in mothers of premature infants compared with mothers of healthy full term infants.<sup>8</sup> Up to 40% of new mothers with premature infants report postpartum depressive symptoms.<sup>8</sup> Premature infants are at risk for altered growth and development independent of maternal postpartum depressive symptoms.<sup>9</sup> Half of very low birth weight infants (infants born less than 1500 grams) are affected by developmental delays including poor growth, behavioral problems, and cognitive delays<sup>10-12</sup> and 2/3 of low birth weight infants (infants born less than 2500 grams) are also born prematurely.<sup>13</sup> Further, the consequences of prematurity continue into adulthood with increased rates of hospitalization and chronic disease.<sup>14</sup> Thus, emotional distress for parents after a premature birth is not unexpected. Unfortunately, elevated maternal postpartum depressive symptoms places premature infants at an even greater risk for altered growth and development compared to premature infants with non-depressed mothers.<sup>15-17</sup>

Although prematurity is an established risk factor for postpartum depression,<sup>8,18</sup> current clinical practice in the NICU does not include routine screening of mothers for depressive symptoms. Without routine screening, clinicians must individually identify mothers who need further evaluation based on known risk factors. Mothers of premature infants who are more likely to have elevated depressive symptoms include history of depression, increased parental stress, married, and have infants on prolonged ventilation.<sup>19,20</sup> These data, however, are not specific to urban, low-income mothers, who may have different risk factors than their more affluent counterparts.<sup>21,22</sup> Identifying risk factors among urban, low-income mothers may enable NICU healthcare providers to more effectively screen and refer mothers with potentially elevated postpartum depressive symptoms.

## Methods

### Design

This descriptive cross-sectional study of mothers with NICU infants was part of a larger randomized clinical trial comparing the effects of two interventions on maternal psychosocial status and infant well-being.<sup>23,24</sup> Data for this analysis were collected through mother report and infant medical record review at baseline prior to the administration of the intervention.

### Setting

Participants were recruited from two tertiary care NICUs in the Midwest. These hospitals were community-based inner-city medical centers serving underserved and uninsured populations. These hospitals were used as a proxy for low maternal income. One hospital was a county hospital serving only the uninsured. The second hospital serves a low income Hispanic community.

### Sample

The convenience sample included 113 mothers of very low birth weight (less than 1500 grams) preterm (less than 37 completed gestational weeks) infants. We included English-speaking mothers without a current mental health diagnosis, whose infants were clinically stable and did not have a congenital neurological problems or symptoms of substance abuse.

We excluded mothers younger than 18, those who had ongoing critical illness (e.g., Human Immunodeficiency Virus, seizure disorders, etc.), or a current diagnosis of major depression, psychosis, or bipolar disease. We also excluded mothers of infants currently receiving mechanical ventilation.

## Measures

Mothers responded to a socio-demographic questionnaire in which they indicated their age, race, education, and whether or not they lived with the baby's father. Additionally, they responded to a series of previously validated scales to measure state anxiety, posttraumatic stress symptoms, parental stress, and depressive symptoms.

Infant illness severity data were obtained through infant medical record review. Severity of the infant's illness was assessed using the Neurobiologic Risk Score (NBRS) based on the medical record. The NBRS is a 7-item assessment of potential insults to an infant's brain that correlate to development at 6, 15, and 24 months.<sup>25</sup> This scale was specifically designed to assess premature infants, with healthy full term infants expected to score "0".<sup>26</sup> Each item is ranked by severity on a 4-point geometric grade (0, 1, 2, 4). Scores on the NBRS correlate between -0.37 and 0.76 with the Bayley II mental and psychomotor developmental indices and neurologic examinations suggesting that illness severity is related to developmental outcome.<sup>26</sup> The Cronbach's alpha of the NBRS for this sample was 0.71. Scores 4 were considered low risk, 5 – 7 was considered intermediate risk, and 8 was considered high risk.<sup>25</sup>

State anxiety was measured using the state subscale of the State-Trait Anxiety Inventory (STAI).<sup>27-29</sup> The STAI has been validated in many languages and used with diverse populations including black and Hispanic samples.<sup>30</sup> The state subscale consisted of 20 items rated on a 4-point Likert scale (1 = not at all and 4 = very much so) and included topics such as the degree to which the mother currently felt happy, calm, comfortable, jittery, upset, and confused. A higher score is associated with higher levels of anxiety.<sup>31</sup> The Cronbach's alpha for our sample was 0.93.

Posttraumatic stress symptoms were assessed using the Perinatal Post-Traumatic Stress Disorder Questionnaire (PPQ).<sup>32-35</sup> The PPQ is a 14 item yes/no questionnaire with statements concerning the mother having upsetting memories of giving birth, avoiding thinking about the baby's hospital stay, an inability to remember parts of the hospital stay, and difficulty feeling loved. A score of 6 or greater represents significant posttraumatic stress symptoms and at risk for posttraumatic stress disorder. Cronbach's alpha for the PPQ in this sample was 0.79.

Parental stress was measured using the Parental Stressor Scale: NICU (PSS: NICU). The PSS: NICU consists of two subscales including parental role alteration (12 items) and infant appearance and behavior (16 items). The PSS: NICU uses a 5-point Likert scale ranging from "not at all stressful" to "extremely stressful".<sup>36</sup> Cronbach's alpha for this sample was 0.90 for the parental role alteration subscale and 0.91 for the infant appearance and behavior subscale.

Postpartum depressive symptoms were measured using the Center for Epidemiologic Studies Depression Scale (CESD). The CESD consists of 20 depressive symptoms rated on a 4-point Likert scale (0 = rarely or none of the time and 3 = most or all of the time) with scores ranging from 0–60. A score greater than 16 indicates clinically elevated depressive symptoms.<sup>37</sup> The CESD was not developed to assess postpartum women, yet in the general population it is widely used to screen for Major Depressive Disorder.<sup>2,37,38</sup> In postpartum women, and specifically mothers of premature infants, the CESD had internal consistency of 0.82 – 0.91, a sensitivity of 60%, and a specificity of 92%.<sup>39,40</sup> The Cronbach's alpha for this sample was 0.90.

## Procedures

The Institutional Review Boards at each clinical site and the university approved this study. Healthcare staff in the NICU notified the research team when a new mother and her infant met inclusion criteria. A member of the research team approached eligible new mothers at their infants' bedside to explain the research study, obtain informed consent, and at this time also completed all questionnaires. A convenience sample of 113 women was enrolled in the first three months postpartum. More specifically, 60% of new mothers were enrolled in their first postpartum month, 30% enrolled by month two, and 10% enrolled by month three. A member of the research team reviewed the infant's medical records and completed the Neurobiologic Risk Score (NBRS). Women received \$10 reimbursement for their time involved with completion of the study.

## Analysis

First, descriptive statistics were computed to describe the sample. Next, Pearson correlations were used to examine the unadjusted relationships among variables (i.e., severity of infant's illness, education, state anxiety, posttraumatic stress symptoms, and parental stress). *T*-tests and analysis of variance (ANOVA) were also conducted to describe unadjusted relationships between postpartum depressive symptoms and maternal age > 35, living with the baby's father, and race, respectively. Variables significant at  $p < 0.10$  were used as candidates for our multivariate linear regression model. Our adjusted model was built using forward stepwise selection where variables were entered at  $p < 0.05$  and excluded at  $p > 0.10$ .

## Results

### Sample Characteristics

The average age of women in our sample was 24.7 (SD = 5.17) years, and ages ranged between 18 and 43 years. Subjects were predominately African American (81%), and 43% had graduated from high school. Approximately 39% received public aid and an additional 40% were uninsured. Overall, subjects had moderate anxiety (mean = 39.1, SD = 12.6), with 30% of mothers having elevated posttraumatic stress symptoms (score > 6 on PPQ), and 42% reporting elevated postpartum depressive symptoms (score > 16 on CESD) (Table 1). Of note, women recruited in the first and second month postpartum (90% of our sample) did not differ in posttraumatic stress symptoms or in postpartum depressive symptoms.

### Factors Associated with Postpartum Depressive Symptoms: Unadjusted Analysis

Depressive symptoms were directly correlated with levels of posttraumatic stress [ $r_{(111)} = 0.673, p < 0.001$ ], levels of state anxiety [ $r_{(111)} = 0.658, p < 0.001$ ], infant illnesses [ $r_{(111)} = 0.276, p = 0.003$ ], and parental stress [ $r_{(111)} = 0.508, p < 0.001$ ] (Table 2). The relationship between depressive symptoms and maternal age over 35 [ $t_{(109)} = 1.88, p = 0.06$ ] and between depressive symptoms and not living with the baby's father [ $t_{(109)} = 1.72, p = 0.09$ ] had a  $p < 0.1$  (approaching significance) and will be included in our model below. There were no significant differences in postpartum depressive symptoms among the three racial groups (white, black, and Hispanic).

### Factors Associated with Postpartum Depressive Symptoms: Adjusted Analysis

Our multivariate model explained 67% of variance in depressive symptoms. Factors associated with postpartum depressive symptoms in our final linear regression model included higher levels of posttraumatic stress symptoms, state anxiety, maternal age, and not living with the baby's father (Table 3). Posttraumatic stress symptoms, state anxiety, and maternal age were all directly related to postpartum depressive symptoms. Living with the baby's father was inversely related to postpartum depressive symptoms. Severity of infant illness and parental stress were not predictive of postpartum depressive symptoms in this sample.

## Discussion

In our sample of low-income urban mothers with very low birth weight premature infants, a large percentage of mothers (42%) experienced elevated postpartum depressive symptoms and posttraumatic stress symptoms (30%). In addition we identified increased depressive symptoms in women with higher levels of posttraumatic stress symptoms, state anxiety, maternal age, and those not living with the baby's father.

The prevalence of elevated postpartum depressive symptoms and posttraumatic stress symptoms in this sample is congruent with previous studies. Previous studies reported 39% of mothers ( $n = 67$ ) with medically fragile infants<sup>41</sup> and 48% of low-income mothers<sup>2</sup> ( $n = 774$ ) had elevated postpartum depressive symptoms. Posttraumatic stress symptoms have been identified in 53% of mothers ( $n = 30$ ) with premature infants<sup>42</sup> and a diagnosis of Posttraumatic Stress Disorder (PTSD) occurs in 15% of mothers ( $n = 86$ ) with infants in the NICU.<sup>43</sup>

Our multivariate model identified factors significantly associated with increased postpartum depressive symptoms in low-income mothers with premature infants in the NICU. These factors included higher levels of posttraumatic stress symptoms, more state anxiety, greater maternal age, and those not living with the baby's father. Our study suggests that urban, low-income mothers with a very low birth weight infant are at risk for elevated postpartum depressive symptoms, independent of their infant's illness and their parental stress levels. This result is contrary to another NICU study<sup>40</sup> of primarily white, married mothers, in which they found higher infant illness, parental stress, and infant re-hospitalizations significantly related to increased postpartum depressive symptoms.

Further we identified the importance of the support from the baby's father in determining a mother's risk as measured by whether the mother lives with the baby's father. Asking mothers about their relationship with the baby's father in addition to screening mothers for anxiety and posttraumatic stress may more accurately identify mothers at risk for postpartum depression and aid in early treatment to potentially decrease negative sequelae.

Limitations of this study included (1) study design, (2) small sample size, and (3) inclusion of only urban low-income women with a low birth weight infant. This study was a secondary analysis of existing data, and therefore we were limited by the primary study's design and data. Longitudinal data collected prenatally through the postpartum might have provided a more complete understanding of the association between depressive symptoms and risk factors. In addition, more detailed information such as more in depth questions pertaining to the support provided by the baby's father could have been collected. Secondly recruitment limitations based on infant illness (current respiratory support was an exclusion criteria) and decreased mother visitation to the NICU (possible due to limited transportation) contributed to the small sample size and varying chronological ages (one to three months) of enrollment into the study. The third limitation is due to our homogenous sample. Urban low-income women experience life events such as chronic stress, depression, substance use, and chronic health conditions more often than the general population.<sup>44</sup> These events may affect their self-report of stress, anxiety, and depressive symptoms. This sample was specifically chosen based on the known health disparities associated with prematurity and elevated postpartum depressive symptoms.

In summary, we identified that low income urban mothers of very low birth weight infants are at risk for depressive symptoms if they have higher levels of posttraumatic stress symptoms, more state anxiety, greater maternal age, and are not living with the baby's father. These findings suggest that healthcare providers in the NICU need to ask women about their birth experience to help assess for posttraumatic stress symptoms, notice maternal state anxiety when teaching mothers about their infants care, be aware that older women may have an increased risk for depressive symptoms, and inquire about the mothers support, specifically the involvement of the baby's father as a support resource for the new mother. We acknowledge that the most comprehensive way to identify women at risk for elevated postpartum depressive symptoms is to screen all mothers with an infant in the NICU. Unfortunately, with limited resources, time, and current policies, this may not be an option for NICU healthcare providers. Knowing risk factors for low-income, urban, mothers of very low birth weight infants may provide better utilization of resources and referrals.

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**Table 1****Sample Characteristics**

	Mean (SD)	Range
Maternal age (years)	24.7 (5.17)	18 – 43
Infant birth weight (grams)	1073 (342)	420 – 1780
Race/Ethnicity		
% Black	81%	
% Hispanic	15%	
% White	4%	
Education (years)	12.0 (3.65)	8 – 18
% Provided breast milk	67.9%	
% Live with father of the baby	52.3%	
Infant Illness Severity (NBRS)	3.2 (3.10)	0 – 16
State Anxiety (STAI)	39.1 (12.6)	20 – 80
Posttraumatic Stress (PPQ)	3.91 (3.00)	0 – 11
Score greater than 6	30%	
Parental stress (PSS: NICU)	65.1 (29.9)	9 – 137
Parental role scale	32.5 (14.8)	1 – 60
Infant behavior and appearance	32.6 (18.3)	4 – 77
Depressive Symptoms (CESD)	15.9 (11.5)	1 – 51
Score greater than 16	42%	
% Receiving Public Aid	39%	
% Uninsured	40%	

Note. NBRS = Neonatal Neurobiologic Risk Score. STAI = State Trait Anxiety Inventory. PPQ = Postpartum Posttraumatic stress Questionnaire. PSS: NICU = Parental Stress Scale: Neonatal Intensive Care Unit. CESD = Center for Epidemiology Studies – Depressive Scale

Table 2

## Correlates of Postpartum Depressive Symptoms (N = 113)

Variable	1	2	3	4	5	6	7
1. Postpartum Depressive Symptoms	-	.67**	.66**	.10	.28**	-.13	.51**
2. Posttraumatic Stress Symptoms		-	.51**	-.02	.17	.02	.50**
3. State Anxiety			-	.05	.31**	-.11	.43**
4. Maternal Age				-	-.01	.12	.51**
5. Infant Illness					-	-.08	.32**
6. Education						-	-.04
7. Parental Stress							-

Note.

\* p &lt; .05.

\*\* p &lt; .01.

**Table 3**  
**Factors Associated with Postpartum Depressive Symptoms (N = 113)**

Variable	Model $\beta$	95% Confidence Interval
Constant	-14.87**	[-22.5, -7.24]
Posttraumatic Stress Symptoms	1.55**	[1.05, 2.05]
State Anxiety	0.46**	[0.34, 0.58]
Maternal Age	0.35*	[0.08, 0.61]
Living with the Baby's Father	-3.37*	[-6.06, -0.68]

$R^2 = 0.67$

F = 52.27

\*  $p < .02$ .

\*\*  $p < .01$ .

Our adjusted model was built using forward stepwise selection where variables were entered at  $p < 0.05$  and excluded at  $p > 0.10$ . Our multivariate model explained 67% of variance in depressive symptoms