Depressive, Anxious and Perinatal Post-Traumatic Distress in Mothers of Very Low Birth Weight Infants in the NICU

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Abstract

Objective—To compare the trajectories and determine the predictors of maternal distress, defined as a continuous spectrum of symptomatology and elevated symptomatology, of depression, anxiety and perinatal-specific post-traumatic stress (PPTS), in mothers of very low birth weight (VLBW) infants throughout the neonatal intensive care unit (NICU) hospitalization.

Method—69 mothers completed psychological questionnaires within the first month of their infant's NICU hospitalization and again two weeks prior to NICU discharge. Multiple regression models determined maternal psychological, reproductive, sociodemographic, and infant medical predictors of maternal distress.

Results—PPTS remained stable throughout the NICU hospitalization while other aspects of distress declined. Previous psychological history and infant medical variables predicted higher PPTS but no other aspects of distress. Reproductive variables predicted anxiety and PPTS; history of fetal loss initially predicted lower PPTS, but throughout hospitalization primipara status emerged as a predictor of higher anxiety and PPTS. Sociodemographic variables predicated initial, but not later, depressive distress.

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Conclusion—Psychological screening is important in the NICU. The PPTS profile suggests it may require distinct treatment. Primiparas should be targeted for intervention.

INTRODUCTION

Post-partum psychological distress is gaining recognition as a public health priority as evidenced by emergence of state legislation requiring that licensed health professionals screen all mothers for psychological distress (1,2), or, distribute educational literature about psychological distress as part of standard postnatal care (3). Post-partum psychological distress has largely been defined in the research literature as a broad, inclusive term that captures varying degrees of depression, anxiety, and general post-traumatic stress and/or perinatal-specific post-traumatic stress (PPTS, 4)[1], ranging from relatively mild symptomatology to meeting full Diagnostic and Statistical Manual of Mental Disorders-Fifth Edition (DSM-5) diagnostic criteria. Examples of depressive and anxious symptomatology include sadness and worry, respectively, while PPTS includes hypervigilance and avoidance behaviors that occur across a continuous spectrum of severity, and while distressing for mothers, are not strong enough in number, intensity, or functional impact, to meet specific DSM-5 diagnostic criteria. Elevated symptomatology refers to a higher level of distress and, in relevant literature, indicates that the mothers' symptomatology exceeds certain clinical criteria (e.g. level of symptomatology suggests mother is "at risk" for meeting DSM-5 criteria, or is in "likely need of therapy") (5–8). Overall, investigations of maternal post-partum psychological distress have focused on identification of symptomatology and elevated symptomatology rather than on specific DSM-5 diagnoses. This is because most health care professionals identify and then refer mothers to qualified mental health providers rather than initiate psychological treatment themselves.

When compared to mothers of term infants, mothers of preterm infants hospitalized in the NICU experience disproportionally elevated rates of post-partum psychological distress (hereafter abbreviated to "distress"). Theoretically, this disproportionate distress is explained by conceptualizing preterm birth as a unique sub-type of pediatric medical stressor (9). More specifically, delivery of a preterm infant is considered a violation of mothers' "reproductive story," or cognitive schema about pregnancy, childbirth and parenthood that results in depressive, anxious and PPTS symptomatology (10). Elevated depressive symptomatology is seen in 14–63% of mothers of preterm infants in the NICU as compared to 10–15% of mothers of term infants (7,11). Similarly, elevated anxious symptomatology is found in approximately 43% of mothers of preterm infants in the NICU as compared to 15–23% of mothers of term infants (12,13). Elevated PPTS is the most discrepant aspect of distress as it

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[1]This paper will not focus on other aspects of psychological distress such as psychosis, bipolar disorder or personality disorders

occurs in 24% of mothers of preterm infants in the NICU, but only 3% of post-partum mothers of term infants. (5).

Maternal distress has been shown to decline over the course of a preterm infant's NICU hospitalization (7,14). Rates of elevated depressive symptomatology have been observed to decline from 63% at NICU admission to 30% at 2 months post birth (7). Similarly, rates of elevated post-traumatic stress symptomatology decline from approximately 50% shortly after birth to 27% at 30 days after birth (14). These trends are consistent with clinical recommendations to re-screen mothers of preterm infants throughout their infants' NICU hospitalization (15). However, most investigations of maternal distress in the NICU have measured distress at only one time point (5,13). Relatedly, rates of elevated anxious and PPTS symptomatology across NICU hospitalization have not been studied. Additionally, the extant literature of distress in mothers of preterm infants in the NICU faces two other limitations. First, most investigations of distress among mothers of preterm infants in the NICU have focused on one or two aspects of distress rather than simultaneously comparing and contrasting trends in depressive, anxious and perinatal post-traumatic symptomatology. Second, some prior studies focused on either the continuous spectrum of symptomatology or elevated symptomatology, but not both. Thus, we therefore sought to compare trajectories of and identify predictors of depressive, anxious and perinatal posttraumatic symptomatology and elevated symptomatology in mothers of very low birth weight (VLBW; birth weight<1500 grams, inclusive of extremely low birth weight <1000 gram infants) during the NICU hospitalization.

METHODS

This study was a part of a prospective, longitudinal, examination of 69 mothers and their VLBW infants enrolled in a larger NICU-based NIH investigation (NR010009). The larger NIH-funded study sought to examine the relationship between health outcomes and cost of human milk feedings. Because the larger NIH study was focused only on infant outcomes, this study focused on a subset of mothers of these VLBW infants, and sought to determine the relationship among distress, maternal visitation frequency, provision of human milk (HM; milk from the infant's own mother), parenting behaviors, and longer-term neurodevelopmental outcomes in VLBW infants. The present investigation will report on distress variables. HM results have been published previously (16). Data collection and analyses summarizing visitation, parenting and neurodevelopmental outcomes are currently underway.

Design

Mothers were approached regarding study enrollment by a member of this study's team two to four weeks after the infant's admission to the NICU, and mothers were enrolled from August 2011 through December 2012. A registered nurse with expertise as a research coordinator and clinical responsibility in the NICU introduced this study to mothers in person and/or over the telephone. Informed consent was obtained by this research coordinator, a second trained NICU registered nurse with evening and weekend availability, or the study's primary investigator with evening and weekend availability. Informed consent

was obtained either during mothers' unscheduled visits to the NICU, or during meetings scheduled at a time convenient for mothers. This study was approved by the institutional review board (IRB) at the medical center and all procedures were followed in accordance with the ethical standards of the IRB. Written informed consent was obtained from all participants.

All questionnaires were administered by trained study staff after informed consent was obtained. Psychometric instruments were administered to the mothers at the following time points: T1 (mean 28.1 days after birth) and T2 (mean 14.8 days prior to NICU discharge). Variability existed for the interim days between T1 and T2 [Mean=50.6, Median =49, SD =26.23, range = 7–101]. Individual/case analyses examined mothers with outlier values (more or less than 1.5 SD from the mean) for T1 and T2 interim days and revealed that mothers with extreme T1 and T2 interim day values did not have extreme, or outlier (more or less than 1.5SD from mean) distress values.

Participants

This study was conducted at a 57 bed level IV NICU in an urban academic center. English-speaking mothers over 18 years of age with VLBW infants deemed likely to survive by neonatology attendings were eligible for enrollment in this study.

Psychological Distress Measures

The following measures were administered in the order described below in order to understand depressive, anxious, and perinatal post-traumatic symptomatology and elevated symptomatology. For each of these measures, higher scores indicate more symptomatology.

The *Center for Epidemiological Studies-Depression Scale* (CES-D, 17; T1&T2) is a 20-item measure that assesses the frequency of depressive symptoms. Participants report behaviors and feelings associated with depression on a scale of 0 "rarely or none of the time" to 3 "most or all of the time." The CES-D has been commonly used in this study's population with good internal reliability (α =.81–.90; 4,6,7). CESD clinical cut-off scores used by previous investigations (CESD > 16, 6) were used to define elevated depressive symptomatology.

The *Spielberger State-Trait Anxiety Inventory* (STAI, 18; Trait administered at T1, State administered at T1 &T2), is comprised of a 20-item subscale of "state" or acute/situational anxiety and 20-item subscale of "trait" or generalized subscale. Participants rate their "state" anxiety on a scale of 1 "almost never" to 4 "almost always" and their trait anxiety on a scale of 1 "not at all" to 4 "very much so." The STAI has demonstrated good internal consistency among mothers of VLBW infants (α = .89; 19) and is frequently used with this population (4,13,19,20). STAI clinical cut-off scores used by previous investigations (State scores > 40–50 considered moderate anxiety, State scores 60 considered severe anxiety; 13) were used to define elevated anxious symptomatology.

The *Modified Perinatal Posttraumatic Stress Disorder Questionnaires* (PPQ-M, 8,21; T1&T2) is a 14-item questionnaire designed to measure frequency of PPTS symptoms on a scale of 0 "not at all" to 4 "often, for more than 1 month". It is comprised of arousal,

avoidance/numbing and re-experiencing subscales, is well-validated in the NICU (4,5,8,21) with good internal consistency (α =.90). The PPQ-M's clinical cut-off score of 19 was used to define elevated PPTS symptomatology (8). The cut-off score of 19 has demonstrated good sensitivity (0.82) in correctly identifying mothers in need of a therapy referral (8). Mothers' with PPQ-M scores higher than 19 are approximately twice as likely to be appropriate for therapy/counseling for their preterm birth experiences (8).

Relevant Psychological Distress Covariates

NICU-specific parenting stress and previous number of life events, respectively, have predicted greater depressive (6) and PPTS symptoms (5). These important covariates were quantified with the following questionnaires. For each of these measures, higher scores indicate more stress or greater number of life events.

The *Parental Stressor Scale: NICU* (PSS-NICU, 22; administered at T1 and T2) is a 26-item scale designed to assess the frequency and intensity of parental stress on a scale of 1 to 5, with 1 being 'not at all stressful" and 5 being "extremely stressful" in relation to different aspects of the NICU experience. The PSS-NICU is comprised of three subscales: 1) the Infant Look and Behavior Subscale (13 Items); 2) the Sights and Sounds of the NICU (6 Items) and 3) Altered Maternal Role in the NICU (7 Items).The PSS:NICU has been extensively used in studies of maternal psychological distress in the NICU (4,6,7,20) with strong psychometric properties (α = .91–.93).

The *Life Events Checklist* (LEC, 23; T1) is a 17-item scale that quantifies cumulative lifetime exposure to potentially traumatic events. The LEC provides two total scores, a total score that incorporates proximity to potentially traumatic events (i.e., it happened to you personally, you witnessed it) or a cumulative score of any event that was either experienced or directly witnessed by the respondent. Documentation of history of previously traumatic events is important in comprehensive models of trauma and post-traumatic stress symptomatology (5). The LEC is well-cited in the PTSD literature, has temporal stability ranging from .84-.37 and correlates well to other measures of post-traumatic stress (23).

Psychological History

Psychological history was collected via self-report and medical chart review. Information about mothers' psychological history, history of involvement with the state's Department of Child and Family Services, and history of drug abuse during pregnancy was collected from medical chart review of psychosocial evaluation/history conducted by NICU social workers. As part of a demographic data collection mothers were asked to report significant psychological history in their immediate family members (e.g., parent or sibling). Access to social support also was identified as part of demographic data collection by asking mothers to identify the number of individuals available to help in childcare.

Maternal Sociodemographic and Reproductive Variables

The following measures were collected prospectively as a part of the larger NIH project and were accessed in this study: maternal race/ethnicity, relationship status (single, partnered not cohabitating, cohabitating with partner, married), maternal age, maternal education (highest

level completed), insurance status (public versus private insurance), maternal gravida status, number of previous pregnancies, number of previous fetal losses, history of previous preterm delivery, number of other children, and total number of adults in the home.

Infant Birth and Medical Variables

Infant gender, birthweight (BW) in grams, gestational age (GA) in weeks, number of days on a ventilator, presence of late-onset sepsis, necrotizing enterocolitis, postmenstrual age at discharge (defined as gestational age in weeks plus chronological age in weeks), length of hospitalization in days, discharge home with gastrostomy-tube and discharge home on oxygen therapy were gathered either from the extensive prospective NIH database or from additional medical chart review.

Data Analysis

Descriptive statistics were calculated for maternal sociodemographic and reproductive variables and for infant birth and medical variables. Descriptive statistics and paired-sample t-tests and McNemar tests also were calculated to better understand how psychological distress (e.g., depressive, anxious and perinatal posttraumatic stress symptomatology at T1 and T2 and elevated symptomatology at T2) changed over time. Pearson, point biserial and chi-square analyses were calculated to understand bivariate associations between maternal psychological distress, psychological covariates and psychological history variables, maternal sociodemographic and reproductive variables, and infant birth and medical variables. Variables that were associated with maternal distress at $p<.10$ were entered into hierarchical multiple linear and logistic regression analyses. Consistent with statistical approaches used in similar investigations (13), maternal psychological distress, covariate and history variables were entered into the first step, maternal sociodemographic and reproductive variables were entered into the second step and infant birth and medical variables entered into the third step of each regression. Variables that achieved significance at $p<.15$ at each step were retained for the final models.

Maternal psychological distress variables at T1 were not entered into regression models of their corresponding variable at T2 given problems with multicollinearity.

RESULTS

Descriptive Statistics

Of a subset of 100 eligible mothers from the larger NIH study, 72% initially signed consent, 17% refused or were too difficult to approach, and 11% were not approached given plans for the infant's eminent transfer out of the hospital's NICU. This study's initial refusal/lack of enrollment given eligibility rate is consistent with similar investigations (15.8%; 20). Sixty-nine mothers (100%) completed T1 and 64 mothers (92.8%) completed T2, which is consistent with previous investigations' 70–96.7% retention for mothers of VLBW infants across NICU hospitalizations (7,14).

Infant medical and maternal sociodemographic descriptive data are summarized in Table 1. Mothers were primarily black (54%), low income (Medicaid-eligible) (66%), not married

(68%) and 40% had a history of previous fetal loss. Although the vast majority of mothers did not report a significant psychological history, they did have significant previous exposure to potentially traumatic events. Table 2 summarizes mothers' previous exposure to potentially traumatic events. On average, each mother had been previously exposed to 2.75 potentially traumatic events with sudden, unexpected death of someone close to her (59%), car accident (51%) and "other" (36%) being the most frequently cited events.

These infant and maternal data for mothers with complete T1 and T2 data were not significantly different from mothers with missing T2 data.

Comparison of and Change in Symptomatology and Elevated Symptomatology from T1 to T2

Table 3 provides an overview of maternal psychological distress from T1 to T2. Overall, across time points (T1 and T2), 65.6% of mothers in this study met clinical cut-off criteria for at least one domain of distress (elevated depressive symptoms, and/or anxiety and/or PPTS). Depression and anxiety symptoms decreased significantly over the NICU hospitalization. Despite the degree of distress present in these mothers, fewer than 9% were receiving any type of psychological therapy. None of the mothers were enrolled in therapy immediately prior to delivering their VLBW infant.

Depressive Symptomatology and Elevated Depressive Symptomatology

Table 4 summarizes the final step of multiple regression models predicting depressive symptoms at T1, T2 and elevated depressive symptoms at T2. The only maternal sociodemographic or reproductive variable that emerged as significant in multiple regression analyses was being single and/or being in a relationship but not cohabitating, which related to higher depressive symptoms at T1. No infant birth or medical variables remained significant predictors in the final multiple regressions of depression.

Anxious Symptomatology and Elevated Anxious Symptomatology

Table 5 summarizes the final step of multiple regression analysis of anxiety symptoms at T1, T2 and elevated anxiety symptoms at T2. Among sociodemographic and reproductive variables, primiparas had higher anxiety symptoms at T2 and greater likelihood of elevated anxiety symptoms at T2. Consistent with regression models of depressive symptoms, no infant birth or medical variables remained significant predictors in the final multiple regressions of anxiety.

Perinatal Post-Traumatic Symptomatology and Elevated PPTS Symptomatology

Table 6 summarizes the final step of multiple regression models of PPTS at T1, T2 and elevated PPTS at T2. Greater previous exposure to potentially traumatic events is positively related to PPTS at T1 and T2 and is associated with elevated PPTS near discharge. Reproductive but not sociodemographic variables significantly predicted PPTS. History of fetal loss was associated with significantly lower PPTS at T1 while primipara status significantly predicted higher PPTS and elevated PPTS at T2. In contrast to regression models for depressive and anxious symptomatology, lower birthweight was significantly associated with higher PPTS at T1 and T2.

Post-hoc Analyses

Post-hoc analyses were conducted removing mothers that enrolled in therapy during the NICU hospitalization. These analyses: 1) did not change any results comparing distress and elevated distress at T1 and T2; 2) did not significantly change overall regression results or conclusions. The following changes were noted in individual predictors in regression analyses: Anxious symptomatology at T1 was no longer a significant predictor of depressive symptomatology at T2 or elevated depressive symptomatology at T2; birth weight trended towards significance as a predictor of PPTS at T1 (p=.056 vs. p<.05 with all mothers included in analyses) and primipara status trended towards significance as a predictor of elevated PPTS at T2 (p=.06 vs. p<.05 with all mothers included in analyses).

DISCUSSION

To our knowledge this is the first study to compare the trajectory of and predictors of post-partum psychological distress in mothers of VLBW infants across the NICU hospitalization. The results from the present study have clear clinical applications for medical professionals and mental health providers that interact with mothers of VLBW infants in the NICU.

A novel finding from this study is that PPTS appears to have different characteristics when compared to other aspects of maternal distress in this VLBW population. First, PPTS and elevated PPTS had a distinct trajectory in that these symptoms remained relatively stable across NICU hospitalization whereas other aspects of psychological distress significantly declined. Second, PPTS had different predictors, including greater previous exposure to potentially traumatic events and lower infant birthweight. These findings are likely related to distinct etiologies of PPTS versus depressive and anxious symptomatology and are consistent with increasingly popular psychological theories about the closely-related constructs of depression and anxiety. Clinically, the discrepancies between trends in distress suggest the need for accurate identification and assessment of type of distress and distinct intervention modules and approaches to address PPTS in these mothers of VLBW infants.

To our knowledge, this study is the first to reveal that reproductive factors consistently relate to anxiety and perinatal post-traumatic stress among mothers of VLBW infants. A maternal history of fetal loss is transiently associated with decreased PPTS early in the NICU hospitalization. It is possible that given a history of fetal loss, initial focus on a live, VLBW birth suppresses or over-rides initial PPTS symptoms. Relatedly, a history of fetal loss and its resultant experience with the loss of mother's envisioned "normal, healthy" pregnancy and delivery (10) may lessen the initial shock and stress associated with a VLBW delivery. However, as the initial impression of a live, VLBW delivery passes, other relevant life experiences, such as history of exposure to potentially traumatic events, remain a risk factor for elevated PPTS near discharge. Previous investigations have revealed that exposure to traumatic events predicts higher PPTS in mothers of preterm infants; however, to date no existing studies have revealed that history of fetal loss may be protective against PPTS (4,6,13,14). Previous investigations of psychological distress in mothers of term infants found that history of fetal loss was associated with higher risk of being diagnosed with depression and non-perinatal specific post-traumatic stress disorder (24). However, the previous investigation involved term mothers and did not specifically quantify or

statistically control for previous history of exposure to potentially traumatic events. The finding that primipara status is consistently associated with anxiety and perinatal post-traumatic stress near VLBW infant NICU discharge also is novel in this field. This consistent finding calls for targeted intervention for primiparas, including preparation of a special discharge preparation module near the end of VLBW infant NICU hospitalization.

Maternal sociodemographic variables only predicted depressive symptoms within the first month of VLBW infant NICU admission and did not appear to have a lasting impact throughout the course of NICU hospitalization. In the present investigation being single or being in a relationship but not cohabitating, predicted higher depressive symptomatology within the first month of NICU admission. This is consistent with previous reports that being unmarried and/or being a single parent predicts higher depression during NICU hospitalization (6,7). Also consistent with previous literature, when considered alongside other relevant psychological and reproductive variables, maternal sociodemographic variables did not emerge as consistent or powerful predictors of maternal psychological distress in this study (5,13). This emerging pattern of maternal sociodemographic predictors may be explained by the conceptualization that maternal distress in the NICU results from the violation of a mother's cognitive schema surrounding pregnancy, childbirth and parenthood, and as such, reproductive and other related distress variables dominate over sociodemographic background factors.

Consistent with previous reports, this investigation revealed a generally high prevalence of elevated distress among mothers of VLBW infants (7,13,14). Furthermore, we found that despite the high prevalence of elevated distress (24–37%), there was a very low rate of enrollment in therapeutic services (9%) at the time of NICU discharge. Mothers that enrolled in therapy during their infants' hospitalization were included in analyses as they were thought to represent an important portion of this population. Further, as noted in the post-hoc analyses, removal of these mothers did not significantly alter study findings and conclusions. According to this study's prevalence rates, assuming that a level IV perinatal center admits approximately 150 VLBW infants each year, as does this single-center, approximately 38 mothers will be in need of psychological re-screening, monitoring and either in-house intervention or appropriate referral prior to discharge. This prevalence, combined with the importance of accurately identifying different aspects of distress given their differential trajectories, reinforces the need for specialist intervention for mothers of VLBW infants in the NICU (15). It may be argued that elevated distress is expected for mothers given the circumstances of their VLBW infants' NICU hospitalization; however, a counterargument may offer that, while within expectation, mothers are experiencing symptomatology that is emotionally painful and personally significant and as such warrants therapeutic intervention, nonetheless.

The strengths of this study include the diverse sample of mothers, prospective data collection for all variables and a sample size that is consistent with other research in this area. Limitations include the use of maternal self-report of psychological distress, design that cannot imply cause and effect, relatively small sample size that while consistent with relevant literature potentially reduced statistical power, exclusion of mothers with term or late preterm infants in the NICU, and the fact that this study focused only on the NICU

hospitalization. The present investigation occurred in a NICU with a breastfeeding peer counselor program and it is possible that, while not its primary intention, this program provides psychosocial support to mothers that may impact the generalizability of the current findings (16). An additional weakness was the inevitable variability that existed in the interim days between T1 and T2 data collection because T2 was contingent upon estimated time of discharge, which varied by VLBW infant. The timing of T2 was contingent upon discharge so that mothers' distress could be re-evaluated when the infants' medical status was relatively stable. As noted in the methods, mothers with extreme variability in interim days between T1 and T2 did not endorse extreme distress values. Further, length of stay was included as a potential covariate of distress variables; however, length of stay did not significantly correlate with distress variables in this study.

Future investigations may benefit from pairing maternal self-report with physiological data or corroborating use of others' (e.g., partners or family members) report of maternal distress and behavior. In longitudinal studies, maternal psychological distress in the NICU has been noted to be associated with less sensitive and more controlling parenting (25), social-emotional problems and weaker cognitive development in VLBW children (19). Additional prospective study of this cohort of mothers and infants is underway to determine the longer-term impact of maternal psychological distress on parent variables and neurodevelopmental outcome.

In sum, the present investigation has several clinical "take-home" messages for providers. These findings further highlight the need to screen mothers of VLBW infants for psychological distress with specific measures in order to appropriately identify them. As many clinicians are aware, screening and subsequent referral are easier to recommend than execute with the current state of psychological services. Given varying, and frequently low, reimbursement rates from public insurance for psychological services, the psychological demand exceeds available psychologists and mental health agencies. Waitlists for therapy, particularly in low-income urban areas, can be lengthy and discouraging for distressed mothers. Future comprehensive programming to address distress in mothers of VLBW infants in the NICU should focus on access and/or NICU-based interventions. Additionally, programs formalizing and/or enhancing support for mothers from NICU staff (including MDs, nursing staff and social work) also appear to be an important priority. Psychological interventions for these mothers should include separate aspects of treatment for mothers with PPTS, as has been done in a very recent NICU-based intervention (26) and create separate modules for primiparas. Given implications for maternal quality of life, maternal-medical staff interactions, parenting and child development, continuing to build upon the newer literature of NICU-based maternal distress interventions should be considered a high priority for the fields of perinatology and psychology.

Acknowledgments

References

1. Perinatal Mental Health Disorders Prevention and Treatment Act, Illinois. Public Act 95-0469.

2. Postpartum Depression Law, New Jersey. Public Act C.26: 2-175 et seq.

3. Postpartum Depression and Education Bill, Minnesota. Public Act SF 2278.

4. Holditch-Davis D, Miles MS, Weaver MA, et al. Patterns of distress in African-American mothers of preterm infants. J Dev Behav Pediatr. 2009; 30:193–205. [PubMed: 19412125]

5. Vanderbilt D, Bushley T, Young R, et al. Acute posttraumatic stress symptoms among urban mothers with newborns in the Neonatal Intensive Care Unit: A preliminary study. J Dev Behav Pediatr. 2009; 30:50–56. [PubMed: 19194322]

6. Ballantyne M, Benzies KM, Trute B. Depressive symptoms among immigrant and Canadian born mothers of preterm infants at neonatal intensive care discharge: A cross sectional study. BMC Pregnancy Childbirth. 2013; 12:S1–S11.

7. Miles MS, Holditch-Davis D, Schwartz M. Depressive symptoms in mothers of prematurely born infants. J Dev Behav Pediatr. 2007; 28:36–44. [PubMed: 17353730]

8. Callahan JL, Borja SE, Hynan MT. Modification of the Perinatal PTSD Questionnaire to enhance clinical utility. J Perinatol. 2006; 26:533–539. [PubMed: 16826190]

9. Kazak AE, Kassam-Adams N, Schneider S, et al. An integrative model of pediatric medical traumatic stress. J Pediatr Psychol. 2006; 31:343–355. [PubMed: 16093522]

10. Jaffe, J.; Diamond, MO. Reproductive Trauma: Psychotherapy with Infertility and Pregnancy Loss Clients. Washington, DC: American Psychological Association; 2010.

11. O'Hara MW, Swain AM. Rates and risk of postpartum depression—a meta-analysis. Int Rev Psychiatry. 1996; 8:37–54.

12. Dennis CL, Coghlan M, Vigod S. Can we identify mothers at-risk for postpartum anxiety in the immediate postpartum period using the State-Trait Anxiety Inventory? J Affect Disord. 2013; 150:1217–1220. [PubMed: 23764383]

13. Rogers CE, Kidokoro H, Wallendorf W, et al. Identifying mothers of very preterm infants at-risk for postpartum depression and anxiety prior to discharge. J Perinatol. 2013; 33:171–176. [PubMed: 22678144]

14. Lefkowitz D, Baxt C, Evans JR. Prevalence and correlates of posttraumatic stress and postpartum depression in parents of infants in the neonatal intensive care unit (NICU). J Clin Psychol Med Settings. 2010; 17:230–237. [PubMed: 20632076]

15. Hynan MT, Mounts KO, Vanderbilt DL. Screening parents of high-risk infants for emotional distress: rationale and recommendations. J Perinatol. 2013; 33:748–753. [PubMed: 23807720]

16. Rossman B, Greene MM, Meier PP. The role of peer support in the development of maternal identity for "NICU moms". J Obstet Gynecol Neonatal Nurs. 2015; 44(1):3–16.

17. Radloff L. The CES-D scale: A self-report depression scale for research in the general population. Appl Psychol Meas. 1977; 1:385–401.

18. Spielberger, CD.; Gorsuch, RL.; Lushene, R., et al. State-Trait Anxiety Inventory for Adults: Manual. Palo Alto, CA: Consulting Psychologist; 1983.

19. Zelkowitz P, Na S, Wang T, et al. Early maternal anxiety predicts cognitive and behavioral outcomes of VLBW children at 24 months corrected age. Acta Paediatr. 2011; 100:700–704. [PubMed: 21214883]

20. Lau C, Smith EO, Schandler RJ. Ethnic/racial diversity, maternal stress, lactation and very low birthweight infants. J Perinatol. 2007; 27:399–408. [PubMed: 17592486]

21. DeMier RL, Hynan MT, Harris HB, et al. Perinatal stressors as predictors of symptoms of posttraumatic stress in mothers of infants at high risk. J Perinatol. 1996; 16:276–280. [PubMed: 8866297]

22. Miles MS, Funk SG, Carlson J. Parental Stressor Scale: Neonatal Intensive Care Unit. Nurs Res. 1993; 42:148–152. [PubMed: 8506163]

23. Gray MJ, Litz BT, Hsu JL, et al. Psychometric properties of the life events checklist. Assessment. 2004; 11:330–341. [PubMed: 15486169]

24. Giannandrea SAM, Cerulii C, Anson E, et al. Increased risk for postpartum psychiatric disorders among women with past pregnancy loss. J Womens Health. 2013; 22:760–768.

25. Muller-Nix C, Forcada-Guex M, Pierrehumbert B, Jaunin L, Borghini A, Ansermet F. Prematurity, maternal stress and mother-child interactions. Early Hum Dev. 2004; 79:145–158. [PubMed: 15324994]

26. Shaw RJ, St John N, Lilo E, et al. Prevention of traumatic stress in mothers of preterms: 6-month outcomes. Pediatrics. 2014; 134:481–488. [PubMed: 25157001]

Table 1

Maternal and Infant Socio-demographic and Medical Data

N =69	M ± SD [range], N (%)
Maternal Psychological History Variables	
Significant Psychological History (Mother)	5 (8%)
Significant Psychological History (Family Member)	15 (22%)
History of DCFS Involvement	1 (2%)
History of Substance Abuse During Pregnancy	2 (3%)
Number of Caretakers Available for Childcare	2.2 ± 1.1 [1–5]
Number of Previous Traumatic Events Witnessed or Experienced	2.75 + 2.64 [0–13]
Maternal Sociodemographic and Reproductive Variables	
Maternal Age (years)	27 ±6 [18–40]
Public Insurance	44 (66%)
Education (Highest Grade)	13.4 ± 2.4 [10–20]
Education (High School or Less)	32 (48%)
Race: Black	38 (54%)
Non-Hispanic White	18 (26%)
Hispanic	12(17%)
Asian	1 (1%)
Marital Status: Married	20 (32%)
Cohabitating	12 (19%)
Significant Other/Not Cohabitating	20 (32%)
Single	10 (16%)
Previous Pregnancies (Total Number)	2.5± 1.7 [0–8]
Primipara	23 (34%)
Previous Fetal Loss (Total Number)	0.72 ± 1.12 [0–6]
History of Fetal Loss	28 (40%)
History of Prior Preterm Delivery	7 (10%)
Infant Birth and Medical Variables	
Female Gender	35 (51%)
Birthweight (grams)	957 ± 243 [470–1470]
Extremely Low Birth Weight (BW< 1000g)	36 (52.2%)
Gestational Age at Birth (weeks)	27.5 ± 2 [23.2–32.2]
Extremely Preterm (<28 weeks gestational age)	38 (55.1%)
Very Preterm (28 to <32 weeks)	28 (40.6%)
Preterm (32 to <37 weeks)	3 (4.3%)
Postmenstrual Age at Discharge (weeks)	39.8 ± 5.2 [35.0–55.30]
Severely Abnormal Head Ultrasound	5 (8%)
Sepsis	20 (30%)
Patent Ductus Arteriosus (PDA)	40 (61%)

N =69	M ± SD [range], N (%)
Necrotizing Enterocolitis (NEC)	5 (8%)
Mechanical Ventilation (Days)	14.3 ± 20.2 [0–118]
Length of NICU Hospitalization (LOS, days)	91 ± 37 [37–179]
Discharged Home on Monitor	5 (8%)
Discharged Home on Oxygen	3 (5%)
Discharged Home on G-Tube	5 (8%)

Table 2

Mothers' Previous Exposure to Potentially Traumatic Events

Events That Mothers Had Directly Experienced or Witnessed	N (%)
Unexpected Death of Loved One	41 (59%)
Car Accident	35 (51%)
Other	25 (36%)
Life Threatening Illness	18 (26%)
Violent Death	12 (17%)
Natural Disaster	12 (17%)
Fire or Explosion	11 (17%)
Unwanted Sexual Experience	11 (16%)
Assault with a Weapon	10 (15%)
Physical Assault	10 (14%)
Serious Accident at Work	9 (13%)
Sexual Assault	8 (12%)
Serious Bodily Injury	5 (7%)
Severe Human Suffering	5 (7%)
Exposure to a Toxic Substance	3 (4%)
Combat in War	1 (1%)

[+] Mothers endorsed as many events as were applicable

Table 3

Maternal Psychological Distress at Time 1 and Time 2

Measures	Time 1 N=69 N (%) or M ± SD	Time 2 N=64 N (%) or M ± SD	Time 1 and/or Time 2 N=64 N (%)
Depressive Symptoms	15.20±11.71 [0–48]	12.09±10.45 [0–45] [**]	---
Elevated Depressive Symptoms	23 (33%)	15 (23%)	23 (36%)
Anxiety Symptoms	44.98+ 12.99 [20–68]	36.91 +11.10 [20–66] [***]	---
Elevated Anxiety Symptoms	38 (55%)	23 (36%) [**]	39 (61%)
PPTS Symptoms	10.35 ±10.35 [0–43]	12.41 ±12.41 [0–51]	---
Elevated PPTS Symptoms	17 (25%)	16 (25%)	22 (34%)
Any[+] Elevated Symptoms	38 (55%)	27 (42%)	42 (66%)
Mothers Receiving Therapy	4 (6%)	6 (9%)	

Cut-off for elevated depressive symptoms CESD score > 16; cut-off for elevated anxiety symptoms STAI score> 40; cut-off for elevated PPTS symptoms PPQM score> 19; All statistically significant comparisons remain significant after step-wise Bonferroni corrections;

[*] p<.05,

[**] p<.01,

[***] p<.001;

[+] "any" refers to elevated depressive, anxious, or PPTS symptoms

Table 4

Multiple Regression Models of Depressive Symptoms

	Depressive Symptoms T1	Depressive Symptoms T2	Elevated Depressive Symptoms T2
	β	β	OR (95% CI)
Maternal Psychological Variables			
PPTS Symptoms T1	.50 ***	.40 **	1.17 (1.03–1.33) *
Anxiety Symptoms T1	.42 ***	.29 *	1.08 (.99–1.18) *
Maternal Role T1	----	.17	
Maternal Sociodemographic and Reproductive Variables			
Marital Status	.21 *	---	---
Maternal Age	-----	−.17	.84 (.69–1.02)
Total Model	F =35.43 ***	F= 15.03 ***	χ^2=31.82 ***
	R^2 = .68	R^2 =.55	Negelkerke R= .65

*
p<.05,

**
p<.01,

***
p<.001

Family psychological history, maternal age, Black race, number of other children at home, PSS: Sights and Sounds, PSS: Looks and Behavior and PSS: Maternal Role were associated with depressive symptoms at T1 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Family psychological history, maternal psychological history, PSS: Sights and Sounds, PSS: Looks and Behavior and infant birthweight were associated with depressive symptoms T2 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Maternal psychological history, PSS: Sights and Sounds, PSS: Looks and Behavior, and infant birthweight were associated with elevated depressive symptoms T2 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Table 5

Multiple Regression Models of Anxiety Symptoms

	Anxiety Symptoms T1	Anxiety Symptoms T2	Elevated Anxiety Symptoms T2
	β	β	OR (95% CI)
Maternal Psychological Variables			
Depressive Symptoms T1	.69***	.47**	1.21 (1.09–1.30)***
PPTS Symptoms T1		.25	
Maternal Sociodemographic and Reproductive Variables			
Maternal Age	−.14		
Primipara	---	.21*	7.21(1.54, 33.79)*
Total Model	F=33.39***	F=91.38***	χ²=35.95***
	R² =.54	R²=.52	Negelkerke R= .62

*
p<.05,

**
p<.01,

***
p<.001

Family psychological history, PSS: Sights and Sounds, PSS: Maternal Role, PSS: Looks and Behavior, infant birthweight were associated with anxiety symptoms at T1 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Family psychological history, maternal psychological history, PSS: Sights and Sounds, PSS: Looks and Behavior, PSS: Maternal Role Alteration, exposure to previous traumatic events, and maternal age were associated with anxiety symptoms at T2 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Family psychological history, maternal psychological history, PPTS T1, PSS: Sights and Sounds, PSS: Looks and Behavior, PSS: Maternal Role Alteration, maternal age, history of fetal loss, and gestational age were associated with elevated anxiety at T2 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Table 6

Multiple Regression Models of PPTS Symptoms

	PPTS Symptoms T1	PPTS SymptomsT2	Elevated PPTS Symptoms T2
	β	β	OR (95% CI)
Maternal Psychological Variables			
Previous Exposure to Traumatic Events	.32***	.31*	1.07 (1.01–1.13)*
Depressive Symptoms T1	.62***	.52**	--
Maternal Sociodemographic and Reproductive Variables			
History of Fetal Losses	−.21*	--	.--
Primipara	---	.28**	4.80 (1.26–18.31)*
Infant Birth and Medical Variables			
Birthweight	−.18*	−.24*	.---
Total Model	F= 22.88***	F= 18.52***	χ^2=11.18**
	R^2 = .63	R^2=.59	Negelkerke R= .26

*
p<.05,

**
p<.01,

***
p<.001

Family psychological history, PSS: Sights and Sounds, and PSS: Looks and Behavior, state anxiety, primipara status and maternal age were associated with PPTS symptoms at T1 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Family psychological history, maternal psychological history, PSS: Sights and Sounds, PSS: Looks and Behavior, PSS: Maternal Role Alteration, state anxiety, history of fetal loss and maternal age were associated with PPTS symptoms at T2 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model

Family psychological history, maternal psychological history, PSS: Sights and Sounds, PSS: Looks and Behavior, PSS: Maternal Role Alteration, state anxiety, DS at T1, history of fetal loss, relationship status, birthweight and number of days on mechanical ventilation were associated with elevated PPTS symptoms at T2 at p<.10 but did not maintain significance at p<.15 in the regression, so were not retained in final regression model.