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Maternal Mental Health During the Neonatal Period: Relationships to the Occupation of Parenting

Rachel Harris[1], **Deanna Gibbs**[2], **Kathryn Mangin-Heimos**[3,4], and **Roberta Pineda**[1,3]

[1]Program in Occupational Therapy, Washington University School of Medicine, St. Louis, MO

[2]Barts Health NHS Trust, London, United Kingdom

[3]Department of Pediatrics, Washington University School of Medicine, St. Louis, MO

[4]Department of Psychological and Brain Sciences, Washington University, St. Louis, MO

Abstract

Purpose—To (1) examine the extent of a range of early mental health challenges in mothers with a very preterm infant hospitalized in the NICU and mothers of full-term infants, (2) identify family social background and infant medical factors associated with higher levels of maternal psychological distress, and (3) assess the relationship between maternal psychological distress and maternal perceptions of the parenting role, parenting confidence and NICU engagement.

Methods—At hospital discharge 37 mothers of very preterm infants (32 weeks gestation) and 47 mothers of full-term infants (37 weeks gestation) completed structured assessments of their psychological wellbeing and transition to parenting. Mothers of very preterm infants were also questioned about their NICU visitation and involvement in infant care.

Results—Sixty-four percent (n=54) of mothers experienced psychological distress (n=26, 70% of preterm; n= 28, 60% of full-term). Lower infant birthweight was associated with psychological distress (p=.03). Mothers of very preterm infants had significantly more psychological distress related to having a Caesarean section delivery (p=.02). Higher levels of psychological distress were associated with lower levels of parenting confidence in mothers of both very preterm and full-term infants (p<.02).

Conclusion—Although parents of very preterm infants have higher rates of maternal mental health challenges, mothers of full-term infants at high social risk are also impacted.

Keywords

postnatal; parenting; psychology; NICU; preterm

Address correspondence to: Roberta Pineda, PhD, OTR/L, Washington University School of Medicine, Program in Occupational Therapy, 1 Children's Place, St. Louis MO, 63110, USA, [pineda_r@kids.wustl.edu], Phone: 314-286-1304, Fax: 314-286-1261.

Introduction

Maternal mental health challenges following the birth of a child are significant, with one in seven American mothers experiencing postpartum depression (1, 2). Prior to delivery, mothers experience emotional changes and an increase in hormone production (3). Hormone levels change further following delivery, which can result in increased emotional lability (4) and mental health risks for new mothers. Mothers at the highest risk are those with a history of mental health challenges (5) and those who have heightened situational stress and anxiety, as is the case with a preterm birth (6).

Compared to mothers of full-term infants, mothers of very preterm infants report significantly more anxiety, depression and stress (7–10), with rates of depression as high as 40% (11). Post-traumatic stress symptoms are also relatively common, affecting 23% of mothers with an infant hospitalized in the neonatal intensive care unit (NICU) based on self-report prior to discharge (12), and potentially increasing to 40% by 14 months post delivery (13). These mental health symptoms can disrupt the transition to parenting and a mother's healthy adaptation to the occupation of parenting (14), which may, in turn, adversely impact infant outcomes (15–17). The construct of occupation describes everyday actions an individual needs, wants, or is expected to do (18). Limited engagement in the occupation of parenting during their very preterm infant's NICU hospitalization can be a challenge for many parents (19). Moreover, additional parenting challenges have been described among mothers with mental health symptoms. For example, mothers of full-term infants who experience symptoms of postpartum depression are less responsive in mother-infant interactions, are more likely to use undesirable feeding and sleep practices, and are less likely to attend scheduled medical appointments (20). Similarly, maternal depression following very preterm birth has been shown to predispose a dyad to early interactional difficulties and less developmentally supportive feeding behaviors (13, 21–23) which may impact longer term developmental outcomes (13, 24).

The challenges for mothers of very preterm infants are likely exacerbated by the NICU environment, where maternal stressors can be magnified. Significant sources of stress include the infant's appearance and behaviors and the overwhelming nature of the NICU environment (25). Mothers report that these stressors, and the highly medicalized environment, limit their participation in the care of their infants (25, 26). They also report high levels of stress relating to their loss of parental role, and in particular their ability to hold, care for, and protect their infant from pain (25, 27, 28). Furthermore, mothers who experience avoidant post-traumatic stress symptoms perceive themselves to be less competent caregivers (29). Increased parent participation during NICU hospitalization and support during the transition to home have been identified as strategies to improve parental confidence and reduce maternal mental health stressors (30). However, a better understanding about the psychological challenges facing parents in the NICU and how early difficulties might influence maternal perceptions of their parental role and their engagement in infant care during this time is needed.

This study aimed to (1) examine the extent of a range of early mental health challenges in mothers with a very preterm infant hospitalized in the NICU and mothers of full-term

infants, (2) identify family social background and infant medical factors associated with higher levels of maternal psychological distress, and (3) assess the relationship between maternal psychological distress and maternal perceptions of the parenting role, parenting confidence and NICU engagement.

Methods

Setting and Participants

Two samples of mothers were recruited. These were as follows.

Very Preterm—The first group consisted of mothers of very preterm infants who were recruited within the first week of life based on consecutive admissions to the NICU. Inclusion criteria were mothers who had an infant born 32 weeks estimated gestational age (EGA) and who were free from congenital anomalies. These mothers and their infants were a convenience sample enrolled as part of a study concerned with early oral motor and feeding development. Because inclusion criteria were pre-established, based on the overarching study, the mothers of preterm infants did not have age or drug use exclusions. Very preterm infants were all hospitalized in the level IV NICU at Saint Louis Children's Hospital or in the level III NICU at Barnes Jewish Hospital's Special Care Nursery. Both hospital units are affiliated with each other and are connected by a walkway bridge. Very preterm infants were enrolled from January to June 2015.

Full-term—The second group consisted of mothers of full-term infants (born 37 weeks EGA), cared for on the mother-baby floor of Barnes Jewish Hospital following a normal delivery. These mothers and their infants were enrolled within the first few days of life and prior to hospital discharge (typically day of life 2–4). Mothers were excluded if their full-term infant had a congenital anomaly, any medical complication (including admission to the special care nursery, need for oxygen, or pharmacological treatment), if maternal drug use was identified, if the mother was <18 years old, and/or if the parents did not speak English. Full-term infants were enrolled between March and June of 2016. Of note, since the hospital served an inner city catchment area of St Louis, this sample was characterized by relatively high levels of socially disadvantaged families (see Table 1).

Procedure

The Human Research Protection Office at Washington University approved this study, and mothers provided written informed consent. All infants received standard of care. Standardized and nonstandardized assessments were administered as part of a structured questionnaire that was completed prior to NICU discharge among mothers of very preterm infants [between 35–47 weeks postmenstrual age (PMA)], and within four days of delivery and prior to discharge for mothers of full-term infants. This equated to mothers of very preterm infants completing assessments at an average of 85.1 ± 40.8 days after birth, equivalent to 39.7 ± 3.4 weeks PMA, whereas mothers of full-term infants completed assessments at an average of 2.0 ± 1.0 days after birth.

Measures

Maternal Mental Health—The Parental Stress Scale (PSS) (31), the Edinburgh Postnatal Depression Scale (EPDS) (32, 33), the State-Trait Anxiety Inventory (STAI) (34, 35), and the Modified Perinatal PTSD Questionnaire (PPQ) (36) were used to assess stress, depression, anxiety and post-traumatic stress symptoms. All of these parent-report measures have high test-retest reliability and convergent validity (31–36).

Psychological Distress—To define mothers with any maternal mental health challenges, the outcomes on the standardized measures were combined to form an overall measure of maternal psychological distress. Specifically, mothers were classified as psychologically distressed if they scored above the 75th percentile for the very preterm group on the PSS, EPDS, STAI (state), or modified PPQ. These cut-points equated to a score > 11 on the EPDS, > 33 on the STAI-state and/or a symptom score > 11.8 on the modified PPQ. This approach was used to identify a potentially high-risk group based on existing data showing that 23–40% of mothers of very preterm infants experience more severe mental health challenges (7, 9, 11–13). Of interest was how high levels of psychological distress might impact mothers' confidence, perceptions of their own parental role, and engagement in the NICU. To ensure that mothers with mental health challenges received necessary services, all mothers at the study sites were routinely screened and referred for mental health services as needed.

Infant Factors and Medical Procedures—Extensive infant clinical data was collected from the electronic medical record. For the very preterm group these included sex, race, EGA, birthweight, Apgars at 1 and 5 minutes, breast milk exposure, PMA at discharge and length of stay (LOS) in days. Detailed information about medical diagnoses was also collected including the presence of patent ductus arteriosus (PDA; requiring indomethacin or surgical ligation), intrauterine growth restriction (IUGR), necrotizing enterocolitis (NEC; all stages), retinopathy of prematurity (ROP; all stages) and brain injury. Brain injury was defined as the presence of a Grade III or IV intraventricular hemorrhage (IVH), cystic periventricular leukomalacia or a cerebellar hemorrhage detected on cranial ultrasound or magnetic resonance imaging. Infant medical procedures collected included: days on total parenteral nutrition (TPN), days of mechanical ventilation, days on non-invasive mechanical ventilation (NIMV), days on continuous positive pressure airway (CPAP) and days on nasal cannula. Infant factors collected for the full-term group included EGA, gender, and race. Whether the infant was from a multiple birth was documented. If a mother gave birth to more than one infant, this was documented and medical factors were collected for the infant with the lowest birth weight for inclusion in the analyses. Information from the other infants in a multiple set was not included in the analyses so that there would not be double representation of multiple births in the sample.

Maternal Social Factors—Data was also collected about a range of maternal social background factors from both the maternal questionnaire and medical record. These included maternal age, socioeconomic status (based on self-reported annual household income <$25,000 or >$25,000), education level (college education or less than a college

education), marital status (married, in a relationship, or single), race (Caucasian or non-Caucasian), and employment status (working full-time, part-time or not working).

Parental Role Alteration and Confidence—Each mother's perception of her parental role was assessed for all mothers of very preterm infants using the Parental Role Alterations subscale from the Parental Stressor Scale: NICU (28, 37). The Parental Stressor Scale: NICU measure is different from the PSS, previously described, which was a contributor to psychological distress. The Parental Stressor Scale:NICU was designed specifically to measure NICU-related parental stress, and was not collected on mothers of full-term infants. In addition, parenting confidence was assessed for both mothers of very preterm infants and mothers of full-term infants using the Maternal Confidence Questionnaire (MCQ) (38) and the Infant Care Questionnaire (ICQ) (39).

Engagement in the NICU—Parent engagement during their infant's NICU hospitalization was measured for all mothers of very preterm infants using a custom written questionnaire that assessed parental patterns of visitation ("On average how often did you visit your baby when he/she was in the NICU?" with choices of "I did not visit", "< 1 day per week", "1–2 days per week", "2–3 days per week", "3–4 days per week", "5–6 days per week", and "everyday"; and "When I visited, most often I would stay" with choices of "I did not visit", "< 1 hour", "1–2 hours", "2–3 hours", "4–6 hours", "6–8 hours", "8–12 hours", and "overnight"). The number of visitation hours reported was then coded as either low (<16 hours per week) or high (>16 hours per week), with the cut-off established based on the median weekly visitation hours. Parent engagement variables were not collected for mothers of full-term infants.

Statistical Analysis

Statistical analyses were run using IBM's Statistical Package for the Social Sciences version 21.0. Differences in infant and maternal factors were compared using independent samples t tests and chi-squared analysis depending on the distributional properties of variables of interest. Between group differences in maternal mental health measures were also examined using independent samples t tests, while controlling for infant and medical factors that differed across groups. Predictors of psychological distress were identified by estimating a factorial generalized linear model with a binomial variable (psychological distress) with logit link. This allowed for exploration of differences across groups (very preterm versus full-term), assessing main effects of each explanatory variable (predictor) on the whole sample, and determining the interaction of the explanatory variable and whether the mother-infant dyad was preterm or full-term (to determine if the relationship differed based on whether the mother-infant dyad was born very preterm or full-term). Relationships between psychological distress and parenting confidence (MCQ and ICQ) were explored by fitting a factorial general linear model for continuous variables on each factor. Relationships between psychological distress and parental role alteration (Parental Stressor Scale: NICU) in the very preterm group were explored using linear regression models. Relationships between psychological distress and parent engagement in the NICU were explored using logistic regression. The relationships between parent engagement in the NICU and parental role

alteration (Parental Stressor Scale: NICU) and confidence (ICQ and MCQ) were explored using linear regression models.

Results

One hundred mother-infant dyads (50 very preterm and 50 full-term) were enrolled. Among those mothers giving birth to a very preterm infant, one of their infants expired, one transferred, six were multiple births, and five mothers did not complete the full questionnaire, leaving a final sample of 37 mothers in the very preterm group. Of the 50 full-term mother-infant dyads, three births were multiples, leaving 47 in the full-term group.

Sample descriptives are shown in Table 1. As shown, there were more non-Caucasian mothers (p=.002), fewer Cesarean section deliveries (p=.001), and mothers had more children (p=.03) in the full-term group. Across both groups, 48% of mothers reported having an annual household income of less than $25,000 USD.

Table 2 describes the scores of mothers in the two study groups on each of the mental health measures, in addition to the proportion of mothers who were subject to high levels of depressive, anxiety and post-traumatic symptoms. Results show that mothers of very preterm infants were characterized by more postpartum depression symptoms on the EPDS (30% among very preterm and 13% among full-term mothers; p=.02), higher stress scores on the PSS (26.7 ± 5.4 among very preterm and 30.1 ± 9.8 among full-term mothers; p=.01) and higher PTSD scores on the Modified PPQ (8.3 ± 7.6 among very preterm and 4.7 ± 6.9 among full-term mothers; p=.03).

Among the 26 (70%) mothers of very preterm infants with psychological distress, 10 (27%) had elevated stress levels, 10 (27%) reported heightened depressive scores, 12 (32%) had increased state anxiety, and 9 (24%) reported elevated post-traumatic stress symptoms. Of the 12 mothers who had high state anxiety, 6 (50%) also had high trait anxiety. Fifteen (58%) had scores above the 75th percentile on one measure, with 7 (27%) having two heightened scores and 4 (15%) having more than three heightened scores.

Among the 28 (60%) mothers of full-term infants who were psychologically distressed, 22 (47%) had elevated stress, 6 (13%) had heightened depression scores, 16 (34%) had high state anxiety and 4 (9%) reported post-traumatic stress scores above the 75th percentile. Of the 16 mothers who reported high state anxiety, 11 (69%) also had high trait anxiety. Fifteen (54%) scored high on one measure, 8 (29%) on two, and 5 (18%) on more than three of the measures of maternal mental health.

Predictors of maternal psychological distress, and differences between mothers in the very preterm and full-term groups, are reported in Table 3. Giving birth to a low birthweight infant was associated with higher levels of psychological distress among mothers in the very preterm group (p=.03). More psychological distress was also observed among mothers who had a Cesarean section delivery (p=.02) for mothers of very preterm, but not full-term, infants.

Table 4 outlines the parental role alteration, parenting confidence and engagement scores of mothers in the very preterm and full term groups. No significant differences in parenting confidence were observed among very preterm, compared to full-term, mothers.

Relationships between psychological distress and parental role alteration, parenting confidence, and engagement are in Table 5. There were no differences in MCQ and ICQ confidence scores among very preterm and full-term mothers. Psychological distress was related to lower confidence scores on the MCQ (p<.0001) and lower confidence scores on the Mom and Baby Subscale (p=.02) and Emotionality Subscale (p=.001) of the ICQ. The full-term mothers, but not the very preterm mothers, had lower scores on the Responsiveness Subscale of the ICQ (p=.01).

Relationships between parent engagement in the NICU and parental role alteration, stress and parenting confidence are defined in Table 6. Twenty-seven (73%) mothers of very preterm infants reported high weekly visitation (>16 hours). Among mothers of very preterm infants, higher levels of reported weekly visitation was related to less parental role alteration on the Parental Stressor Scale: NICU (p=.03). Mothers with more NICU visitation also scored higher on the Emotionality Subscale of the ICQ (p=.03).

Discussion

The key findings of this study include that high levels of maternal mental health challenges were observed in mothers following both very preterm and full-term birth, with 64% of mothers having psychological distress. The experience of psychological distress was different between very preterm versus full-term mothers, with full-term mothers reporting more parenting stress and very preterm mothers reporting more post-traumatic stress symptoms and more depression. Interestingly, the impact of Cesarean section delivery on psychological distress was different for very preterm versus full-term mothers, with very preterm mothers having significantly more psychological distress related to Cesarean section delivery. In addition, more psychological distress was observed in mothers of very preterm infants at lower birthweights. Psychological distress negatively impacted parenting confidence among both very preterm and full-term mothers. However, mothers of full-term infants with psychological distress were more likely to have decreased confidence in dealing with the infant's responses during interactions. More parent engagement in the NICU among mothers of very preterm infants was related to less parental role alteration and parents having greater confidence in handling infant irritability.

Mothers from both groups experienced mental health challenges, with 70% of mothers of very preterm infants and 60% of mothers of full-term infants being psychologically distressed at hospital discharge. Mothers of very preterm infants reported higher levels of depressive and post-traumatic stress symptoms, while mothers of full-term infants reported more stress. Our findings are consistent with previous reports of high rates of depressive and post-traumatic stress symptoms among mothers of very preterm infants (11–13). Our findings are inconsistent in regards to higher stress levels in mothers of full-term infants, as previous research identifies higher stress in mothers of very preterm infants (25, 40). However, it is possible that the current findings reflect a difference in timing of assessment

of symptoms compared to other studies. Given the increased emotional and hormonal changes that occur immediately after delivery (41, 42), it is plausible that the emotional changes related to the timing of assessment impacted our findings of heightened levels of stress which were observed in the days immediately following birth among mothers of full-term infants. The higher rate of maternal mental health challenges observed in this cohort, compared to previous reports, could also relate to the sample consisting of a socially disadvantaged group of mothers. Previous evidence suggests that mother's occupation, marital status, perceived social support, socioeconomic status, and financial strain play a predictive role in prevalence of postpartum depression (4). In our sample of mothers of very preterm and full-term infants, 48% of mothers had a household income < $25,000 USD. While 80% of our sample was in a serious relationship, only 36% were married. Given previous research that supports higher rates of postpartum depression among mothers who report lower social support and socioeconomic status, these social factors may have impacted the high rates of mental health challenges that were observed.

Previous studies have identified environmental and sociodemographic factors related to psychological distress. Among mothers of full-term infants, predictors of acute psychological distress have included having a single relationship status, multiples, or a prior traumatic birth (43). Younger maternal age including being an adolescent mother, lower infant EGA and birthweight, and more days on ventilation have also been found to relate to higher rates of psychological distress among mothers of preterm infants (44, 45). However, we identified few mother or infant factors that were related to psychological distress for mothers in this study. Interestingly, the impact of Cesarean section delivery on psychological distress was identified only in the very preterm group in this study. Reasons for Cesarean section delivery among preterm infants can be multifactorial and may include infant factors (distress, breech presentation with imminent delivery) or maternal factors (anatomic, maternal health complications) (46). The relationship of Cesarean section delivery to psychological distress in mothers of preterm infants may be due to the separation of mothers from their very preterm infants after delivery. Most hospitals have separate units for mothers for postpartum recovery and infants being hospitalized in the NICU. This results in mother-infant separation when the infant is transferred to the NICU immediately following delivery and the mother remains in post-delivery recovery. In contrast, most mother-baby units strive to keep mothers together with their infants after full-term delivery (47), even following Cesarean section delivery (as was the model with the full-term group in this study). Recent research has found that mothers who are provided opportunities to bond with their baby early during their NICU stay have fewer depressive and anxiety symptoms (48). Therefore, it is plausible that the maternal-infant contact allowed within current models for full-term infants, in contrast to the separation which occurred between very preterm mother-infant dyads, relates to the higher levels of psychological distress observed in mothers of very preterm infants following Cesarean section delivery.

Among mothers of very preterm infants, more psychological distress was observed in those whose infants had lower birthweights. Parents of infants with lower birthweights may have more stressors related to their infant's medical status, which could explain why lower birthweight was related to more psychological distress in the current sample. This is consistent with others who have found a longer length of hospitalization, lower birthweight

and worse medical condition to be related to symptom severity (13, 23, 45, 49–51). Feeling unable to protect the infant from harm, mothers experience a range of feelings from grief to extreme stress (52). Due to the life and death circumstances for infants in the NICU and mothers' heightened stress over a prolonged period, post-traumatic stress disorder has been described in mothers of preterm infants (12, 23, 30, 53). Our findings of 8% of mothers of very preterm infants having post-traumatic stress symptoms at NICU discharge is lower than previously reported rates that range from 23% to 41% (12, 13, 54–56); however post-traumatic stress symptoms can appear several years following the stressful exposure (57), and symptoms may appear after mothers have transitioned home with their infants (58).

Psychological distress among the very preterm and full term mothers was related to lower parenting confidence, which has implications for mother-infant outcomes. Psychologically distressed mothers are less likely to engage in positive parenting behaviors including providing discipline, attending medical/dental appointments, and providing educational or cognitively stimulating activities (59, 60). Moreover, distressed mothers are likely to be less sensitive and more controlling during interactions with their infants (50, 61).

While mothers of very preterm infants in this study experienced an increased prevalence of mental health challenges, when compared to mothers of full-term infants, engagement in the NICU was related to more confidence and less parental role alteration. This suggests that parent engagement during NICU hospitalization might help moderate some of the stress of the NICU experience. Previous research supports that programming in the NICU can improve mothers' short term psychological well-being (8, 62, 63). Specifically, parents who have received programming that promotes and empowers them to care for their infants, compared to controls who received standard of care, demonstrated decreased parent stress, depression, and anxiety (64–66). However, parents can experience barriers to engagement in the NICU (67–71). Many parents currently are constrained by fear of losing their job or being unable to have adequate income (72), and this can alter the ability to engage in NICU care.

This study was limited by its observational nature. It had a small sample size and no a priori calculation of power was conducted, due to its use of a convenience sample. Due to the convenience sampling, the inclusion criteria for very preterm and full-term mother-infant dyads differed, including mothers of full-term infants being excluded due to identified drug use and age <18 years. This study used multiple comparisons, which increases the risk of a type I error. However, due to its exploratory nature, it sets the stage for larger trials. This study was conducted in an urban area, with a diverse sample and high rates of low socioeconomic status, which limits the generalizability of the findings. This study also used self-report measures of maternal mental health, which may have resulted in over-reporting or under-reporting of symptoms. Finally, the timing of the measures limits the findings, as they only represent a point in time, and long-term follow up has not been conducted.

Clinical applications of findings include that mothers would benefit from careful surveillance of maternal mental health so that services can be identified and implemented early. For mothers of very preterm infants, parent engagement during the NICU stay could potentially aid in moderating the effects of maternal health challenges. In addition,

improving resources to enable couplet care (73) across hospital settings could potentially decrease psychological distress in mothers of very preterm infants following Cesarean section delivery. Finally, expanding national policies to enable unrestricted parent-child contact in the postpartum period, especially in those born very preterm, could have significant implications for maternal and child health.

Acknowledgments

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Highlights

- Sixty-four percent of mothers experienced psychological distress; rates did not differ between mothers of preterm and full term infants.

- Mothers of full term infants reported more parenting stress, but fewer post-traumatic stress symptoms, than mothers of preterm infants.

- Lower infant birthweight was related to more psychological distress among mothers of preterm infants.

- Having a Cesarean section delivery was related to psychological distress among mothers of preterm infants, but not among mothers of full term infants.

- Mothers with psychological distress demonstrated less confidence than mothers without psychological distress.

- More engagement during NICU hospitalization was related to more parenting confidence and less parental role alteration.

Table 1

Sample demographics and differences between preterm and full-term mother-infant dyads.

	Total Sample (n=84)	Preterm Group (n=37)	Full-term Group (n=47)	
	Mean ± SD; or N (%); or Median (IQR)			*p-value*
Infant Factors				
EGA	33.8 ±5.8	27.8 ±2.7	38.6 ±1.1	**<.0001**
Female Gender	45 (54%)	18 (49%)	27 (57%)	.33
Non Caucasian Race	51 (61%)	16 (43%)	35 (74%)	**.002**
Birthweight (g)		1104.0 ±416.7		
Apgars at 1 min		3.7 ±2.5		
Apgars at 5 min		5.8 ±2.06		
Breast Milk Fed		32 (87%)		
Breast Milk at Discharge		18 (49%)		
PDA		9 (24%)		
IUGR		3 (8%)		
NEC		4 (11%)		
Brain Injury (n=36)		8 (22%)		
ROP		11 (30%)		
PMA at Discharge (n=35)		39.7 ±3.4		
LOS (days) (n=35)		83.4 ±40.9		
Infant Medical Procedures				
Days on TPN		11 (6—18.5)		
Days on Vent		1 (0–16.50)		
NIMV days		13.4 ±18.1		
Days on CPAP		2.0 ±4.3		
Days on Nasal Cannula		28.5 ±24.7		
Maternal Factors				
Maternal Age	28.4 ±6.2	29.7 ±6.4	27.4 ±6.0	.13
Cesarean Section Delivery	43 (51%)	27 (71%)	16 (34%)	**.001**
Multiple Birth	7 (8%)	5 (13%)	2 (4%)	.14
Other Children (n=45)	56 (67%)	21 (55%)	35 (78%)	**.03**
Marital Status, Single (n=45, full-term)	16 (20%)	7 (19%)	9 (20%)	.86
Income <$25,000 (n=36, preterm; n=43, full-term)	40 (48%)	16 (43%)	24 (56%)	.45
College Degree	26 (31%)	15 (41%)	11 (24%)	.14

Note: Columns shaded black indicate variables that are unique to the preterm group and were not collected for full-term mother-infant dyads. EGA: Estimated Gestational Age; PDA: Patent Ductus Arteriosis; IUGR: Intrauterine Growth Restriction; NEC: Necrotizing Enterocolitis; PVL/IVH: Periventricular Leukomalacia/Intervertebral Hemorrhage; ROP: PMA: Postmenstrual Age; Retinopathy of Prematurity; LOS: Length of Stay; TPN: Total Parenteral Nutrition; NIMV: Non-Invasive Mechanical Ventilation; CPAP: Continuous Positive Airway Pressure

*
p-value is from investigations of differences between full-term and preterm mother-infant dyads using independent samples t tests (for continuous variables) and chi-square analysis (for categorical variables). Bolded values indicate significance, p <.05

Table 2

Prevalence of maternal mental health challenges and differences in maternal mental health characteristics among full-term compared to preterm mother-infant dyads.

	Total Sample (n=84)	Preterm Group (n=37)	Full-term Group (n=47)	* p value for univariate analysis	** p value for multivariate analysis
		Mean ± SD; or N (%)			
Maternal Mental Health					
Depression (EPDS)	6.39 ±3.92	7.08 ±4.23	5.85 ±3.61	.21	.17
Postpartum Depression symptoms **	17 (20%)	11 (30%)	6 (13%)	.055	**.02**
Stress (PSS)	28.62 ±8.32	26.70 ±5.42	30.13 ±9.83	**.009**	**.01**
State Anxiety (STAI 1)	30.15 ±11.31	30.11 ±8.52	30.19 ±13.19	.78	.69
Trait Anxiety (STAI 2)	30.08 ±9.01	30.39 ±7.89	29.85 ±10.00	.98	1.0
Post-traumatic Stress (Modified PPQ)	6.23 ±7.38	8.25 ±7.57	4.68 ±6.92	**.03**	**.03**
PTSD symptoms ***	6 (7%)	3 (8%)	3 (6%)	.50	.90
Psychological Distress ****					
Psychologically Distressed	54 (64%)	26 (70%)	28 (60%)	.31	.58

*
p-value is from investigations of differences in maternal mental health among full-term compared to preterm mother-infant dyads using independent samples t tests (for continuous variables) and chi-square analysis (for categorical variables). Bolded values indicate significance, p <.05.

**
p-value is from investigations of differences in maternal mental health among full-term compared to preterm mother-infant dyads using linear (for continuous variables) and logistic (for categorical variables) regression models, controlling for race, type of delivery, and siblings, p<.05. Note: type of delivery, race, and number of children were all related to each (p<.05) in chi-square analysis but all were included in the model. Analyses re-run controlling only for c-section and the findings remained largely unchanged.

**
Postpartum depression symptoms defined as having a score of >10 on the EPDS

***
PTSD symptoms defined as having a score of >19 on the Modified PPQ

****
Psychological distress was defined as scoring above the 75th percentile on the PSS, EPDS, STAI (state), or modified PPQ.

Abbreviations: EPDS: Edinburgh Postnatal Depression Scale; PSS: Parental Stress Scale; STAI: State and Trait Anxiety Scale; Modified PPQ: Modified Perinatal Post-traumatic Stress Questionnaire

Table 3

Predictors of psychological distress: Main effects and interactions between groups.

	Main Effect of Being Preterm vs. Full-term		Main Effect of Explanatory Variable (n=84)		Interaction of Being Preterm vs Full-term and Explanatory Variable		Preterm Group (n=37)		Full-term (n=47)	
	*p	Beta (CI)	*p	Beta (CI)	*p	Beta (CI)	*p	Beta (CI)	*p	Beta (CI)
Infant Factors										
Female Gender	NS		NS		NS					
Non Caucasian Race	NS		NS		NS					
EGA							.13	−.22 (−.5, .06)	—	—
Birthweight (g)							**.03**	−.002 (−.004, 0)	—	—
Apgars at 1 min							.18	−.21 (−.51, .09)	—	—
Apgars at 5 min							.24	−.24 (−.66, .18)	—	—
Breast Milk							1.0	−20.556 (−35970.16, 35929.04)	—	—
Breast Milk at Discharge							.07	−1.451 (−3.03, .13)	—	—
Infant Medical Procedures										
Days on TPN							.19	.056 (−.024, .136)	—	—
Days on Vent							.44	.015 (−0.025, .055)	—	—
NIMV days							.63	.010 (−.03, .05)	—	—
Days on CPAP							.49	.072 (−.148, .292)	—	—
Days on Nasal Cannula							.44	.012 (−.028, .052)	—	—
Maternal Factors										
Moms Age	NS		NS		NS					
Cesarean section Delivery	.641	1.0 (−.46, 2.5)	.21	.60 (−.63, 1.8)	.015	−2.5 (−4.5, − .47)	**.02**	1.887 (.267, 3.507)	NS	
Multiples	NS		NS		NS					
Other Children	NS		NS		NS					
Single	NS		NS		NS					
Income <$25,000	NS		NS		NS					
College Degree	NS		NS		NS					

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Note: Psychological distress was defined as scoring above the 75th percentile on the PSS, EPDS, STAI (state), or modified PPQ. Infant medical procedures and infant medical factors related to health status (Birthweight, Apgars, and Breast Milk use were only collected for the preterm mother-infant dyads as they were NICU specific variables. Therefore, analyses investigating relationships between those variables and psychological distress are only reported for the preterm group. Other cells related to these factors are therefore shaded black.

*
  p value is from estimating factorial generalized linear model with binomial variable (psychological distress) with logit link. The main effects of being preterm vs. full-term denote if there were differences in the variable across the two groups. The main effects of the explanatory variable denotes if each variable is related to psychological distress in the entire cohort (full-term and preterm; n=84). The interaction p value denotes whether being preterm or full-term has an effect on whether the explanatory variable was related to psychological distress. When the interaction p value is >.05, there is no interaction and main effects can be interpreted. When the interaction p value is <.05, the relationship between the explanatory variable and psychological distress must be interpreted separately for the preterm and full-term groups.

EGA: Estimated Gestational Age; TPN: Total Parenteral Nutrition; NIMV: Nasal Intermittent Mandatory Ventilation; CPAP: Continuous Positive Airway Pressure

Table 4

Prevalence of parental role alteration, parenting confidence & NICU engagement and differences in preterm compared to full-term infants

	Total Sample (n=84)	Preterm Group (n=37)	Full-term Group (n=47)	
	Mean ± SD; or N (%)			**p*
Parental Role Alteration				
PSS NICU		2.84 ±0.79		
Parenting Confidence				
MCQ	42.69 ±7.61	41.46 ±7.76	43.76 ±7.51	.14
ICQ-Mom & Baby	4.45 ±1.15	4.28 ±0.44	4.58 ±1.49	.38
ICQ-Emotionality	4.30 ±0.80	4.30 ±0.93	4.31 ±0.69	.96
ICQ-Responsiveness	3.99 ±0.55	4.03 ±0.51	3.96 ±0.58	.46
Engagement in NICU				
Visited Everyday		24 (65%)		
High Visitation (>16hrs/wk)		27 (73%)		

Note: Parental Role Alteration and Engagement in NICU variables are specific to experiences in the NICU, and therefore were not collected for mothers of full term infants and are shaded black.

*
 p-value is from investigations of differences in maternal mental health among full-term compared to preterm mother-infant dyads using independent samples t tests. Bolded values indicate significance <.05.

PSS NICU: Parental Role Alterations Subscale of the Parental Stressor Scale: NICU; MCQ: Maternal Confidence Questionnaire; ICQ: Infant Care Questionnaire

Table 5

Relationships between psychological distress and parenting confidence, parental role alteration & NICU engagement.

	Main Effect of Being Preterm vs. Full-term		Main Effect of Explanatory Variable (n=84)		Interaction of Being Preterm Vs Full-term and Explanatory Variable		Preterm Group (n=37)		Full-term (n=47)	
	*p	Beta (CI)	*p	Beta (CI)	*p	Beta (CI)	*p	Beta (CI)	*p	Beta (CI)
Parenting Confidence Questionnaire (MCQ)	NS		<.0001	6.6 (2.5, 10.7)	NS					
Mom & Baby Subscale of the Infant Care Questionnaire (ICQ)	NS		.02	.90 (.26, 1.5)	NS					
Emotionality Subscale of Infant Care Questionnaire (ICQ)	NS		.001	.48 (.04, .91)	NS					
Responsiveness Subscale of Infant Care Questionnaire (ICQ)	NS		NS		.03	−.53 (−1.0, −.06)	.57	.11 (−.27, .49)	.01	−.43 (−.75, −.10)
Parental Role Alteration (PSS: NICU)							.85	−.032 (−.650, .541)		
Weekly Visitation (low<16, high>16)							.98	−.018 (.201, 4.793)		

Note: Psychological distress was defined as scoring above the 75th percentile on the PSS, EPDS, STAI (state), or modified PPQ.

*

p value is from fitting a factorial general linear model for the outcome variable on each factor. Bolded values indicate significance <.05.

The main effects of being preterm vs. full-term denote if there were differences in the variable across full-term compared to preterm mother-infant dyads. The main effects of the explanatory variable denotes if each variable is related to psychological distress in the entire cohort (full-term and preterm; n=84). The interaction p value denotes whether being preterm or full-term has an effect on whether the explanatory variable was related to psychological distress. When the interaction p value is >.05, there is no interaction and main effects can be interpreted. When the interaction p value is <.05, the relationship between the explanatory variable and psychological distress must be interpreted separately for the preterm and full-term groups. Cells are shaded black to clarify what analyses to interpret. In addition, parental role alteration and weekly visitation were only collected in the preterm group, so the corresponding cells for those variables under full-term group columns are also shaded black.

Table 6

Relationships between parent engagement in the NICU (weekly visitation >16 hours), parental role alteration & parenting confidence.

	Preterm Group(n=37)		
	Mean ± SD		*p
Weekly Visitation	**Low <16 hours**	**High >17 hours**	
Parental Role Alteration (PSS: NICU)	3.43 ±0.97	2.61±0.58	**.03**
Emotionality Subscale of Infant Care Questionnaire (ICQ)	4.70 ±0.42	4.15±1.03	**.03**

*
p-value is from investigations of relationships between parent engagement and parental role alteration, stress and confidence using independent samples t tests. Bolded values indicate significance <.05. Only those relationships that were significant are listed. There were no other significant relationships identified. PSS NICU: Parental Role Alterations Subscale of the Parental Stressor Scale; PSS: Parental Stress Scale