ORIGINAL ARTICLE

Stress levels and depressive symptoms in NICU mothers in the early postpartum period

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Abstract

Objective: This study examined whether particular maternal and infant factors can identify mothers at risk for increased stress upon admission to the neonatal intensive care unit (NICU). *Methods*: Eighty-five mothers of preterm infants (25–34 weeks gestation) were assessed using the Parental Stressor Scale (PSS:NICU) and the Edinburgh Postnatal Depression Scale (EPDS) within 3.24 ± 1.58 d postpartum. Hierarchical linear regression models were used to determine the extent to which maternal stress is influenced by individual factors. *Results*: Fifty-two percent of mothers experienced increased stress (PSS:NICU score ≥ 3) and 38% had significant depressive symptoms (EPDS score ≥ 10). Stress related to alterations in parental role was the most significant source of stress among NICU mothers. Distance from the hospital and married marital status were significant predictors for stress related to alterations in parental role ($p = 0.003$) and NICU sights and sounds ($p = 0.01$), respectively. Higher stress levels were associated with higher depressive scores ($p = 0.001$). Maternal mental health factors, demographic factors, pregnancy factors and infant characteristics were not associated with increased stress. *Conclusion*: Elevated stress levels and depressive symptoms are already present in mothers of preterm infants upon NICU admission. Being married or living long distance from the hospital is associated with higher stress. Future work is needed to develop effective interventions for alleviating stress in NICU mothers and preventing its potential development into postnatal depression.

Introduction

Premature birth is a highly stressful experience for mothers [1]. The abrupt transition of the infant from the protected environment of the womb to the pressured environment of the neonatal intensive care unit (NICU) presents mothers with a wide range of stressors. These stressors are often related to the sights and sounds in the NICU environment, the fragile appearance of the newborn and the prolonged physical separation. High levels of stress following a premature birth may develop into more severe psychological disorders, including post-traumatic stress disorder and depression [2–4], as well as more adverse health-related outcomes [5]. The prevalence rates of postnatal depression in mothers of preterm infants are as high as 30–40% compared to only 6–12% in mothers of healthy infants born at term (for a review, see [6]). Ultimately, the emotional well-being of mothers may influence the integrity of maternal–infant attachment, which in turn can have a substantial impact on the

infant's emotional, social and cognitive development [7,8]. In light of this, it is important to identify factors associated with increased maternal stress in order to develop effective interventions for improving mental health in NICU mothers.

The Parental Stressor Scale (PSS:NICU), developed by Miles and colleagues [9], was designed to assess parents' perception of stressors arising from the physical and psychosocial environment of the NICU across three domains: their parental role, their infant's behavior and appearance and the sights and sounds in the NICU. Previous studies using the PSS:NICU have demonstrated that the primary sources of stress identified by NICU mothers are related to their parental role and their infant's behavior and appearance, whereas the perception of the NICU environment appears to affect mothers to a lesser degree [2,10,11]. These studies suggest that parental stress levels in the NICU may be influenced by several demographic factors and clinical variables related to both the mother and the infant.

The extent of prematurity and illness severity of the infant have been shown to be predictors of increased levels of maternal stress. Mothers of infants suffering from cardio-respiratory instability had higher stress levels than mothers of otherwise healthy preterm infants [11,12]. In addition, birth

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weight (<1500 g), gestational age (GA) at birth (<28 weeks) and length of stay have been correlated with increased maternal stress [11–13], although more recently, studies have found no association between birth weight, GA, twin birth and maternal stress in the NICU [14].

Other studies examining the association between maternal demographics and stress levels have reported mixed results. Increased stress levels have been found in older [10], unmarried, low-income and less-educated mothers [14,15], as well as in younger, married mothers with high levels of education [11]. However, other studies report no association between heightened levels of stress and maternal demographics, such as age, marital status, education or employment status [10,11,13,16]. The inconsistency of these findings might be attributed to discrepancies in the time of assessment, both between and within studies, ranging from days [16], weeks [10,13,15] and months [11,12] post NICU admission. This study aimed to reduce the possible confounding effect of length of stay by assessing risk factors associated with maternal stress levels within a relatively small time frame upon NICU admission. The rationale behind this approach is that risk factors should be identified early enough in order to administer effective interventions for reducing anxiety and preventing postnatal depression before mothers become symptomatic [17].

Method

Participants

Eighty-five mothers of preterm infants born between 25 and 34 weeks GA were included in this study ($M = 30.14$; $SD = 2.27$). Mothers were assessed within the first week of their infant's admission to the NICU ($M = 3.24$ d, $SD = 1.58$ d). Mothers were excluded from this study if they had an uncontrolled maternal illness; history of maternal smoking, alcoholism and use of illicit drugs; and history of significant maternal abuse. In addition, mothers were excluded if their infant suffered from malnutrition, had chromosomal or congenital anomalies, major congenital infections, prenatal diagnosed brain lesions or birth asphyxia. All mothers gave written informed consent to participate in the study. The rationale for the above-mentioned exclusion criteria lies in the fact that our study aimed to assess stress levels associated with the mere experience of giving birth prematurely. Any other pre-existing potential sources of stress due to maternal history and/or neonatal conditions would have influenced our results. A description of the study population is given in Table 1.

Maternal stress levels

The PSS:NICU [9] was used to measure stress levels in mothers. The PSS:NICU has been shown to have good internal consistency and construct validity within and across the following subscales in the US [16] and Europe [18]: (i) sights and sounds in the NICU (5 items); (ii) infant's behavior and appearance (14 items); and (iii) parental role (7 items). Items are rated on a Likert scale ranging from 1 (not at all stressful) to 5 (extremely stressful). The mean score for each subscale and mean overall scores were calculated. As advised by M. Miles (personal communication, 8 December

Table 1. Maternal and infant characteristics.

Maternal characteristics	
Maternal age (years)	31.96 (5.25)
Married (%)	75.30
College or beyond (%)	60.00
Cesarean section (%)	82.40
Singleton (%)	63.50
First child (%)	58.80
History of depression/anxiety (%)	31.80
Prenatal use of antidepressants (%)	15.30
Distance from hospital (miles)	17.41 (16.47)
Infant characteristics	
Birth GA (weeks)	30.14 (2.27)
Birth weight (grams)	1373.44 (426.27)
Apgar 5' score	7.66 (1.44)
Respiratory support at time of assessment (%)	61.20
DOL at time of assessment	3.24 (1.58)

Values are given as mean (SD) where appropriate.

2013), items rated as ''not applicable'' were not included in the data analysis, and the mean scores for each subscale were calculated based on the number of questions answered.

Maternal postnatal depression

The Edinburgh Postnatal Depression Scale (EPDS) [19] was used to identify depressive symptoms in mothers. The EPDS is a 10-item, self-report questionnaire used to detect women at risk for developing postnatal depression. Items are scored from 0 to 3 (minimum total score $= 0$; maximum total score $= 30$). A total score ≥ 10 has been validated to have a strong predictive value for detecting women at risk for developing postpartum depression [20]. EPDS scores were available for a subset of the study cohort ($N = 31$).

Maternal characteristics

The following maternal characteristics were collected: age (years), type of delivery (vaginal/cesarean); offspring number (multiples/singleton); marital status (married-in a relationship/single); first-time parent (yes/no); education level (college or beyond/some college-high school); distance from the hospital (miles); history of anxiety/depression (yes/no); and prenatal use of antidepressants (yes/no). The information was either recorded at the time of the assessment or obtained through medical records and nursing flow sheets.

Infant characteristics

The following infant characteristics were obtained from medical chart: birth GA (weeks), birth weight (grams), 5 min Apgar scores (Apgar 5') and status of respiratory support at the time of maternal assessment (yes/no). For mothers of multiples, the infant with the most severe clinical presentation (based on birth weight, Apgar 5' score and requirement for respiratory support) was chosen for the analysis in order to best investigate the association between having a severely ill infant and maternal stress, in line with methods used in previous research [21].

Data analysis

In order to determine the extent to which maternal stress is influenced by particular factors the following categories were considered: (i) infant factors: GA, birth weight Apgar 5'

scores and status of respiratory support; (ii) maternal mental health factors: history of anxiety/depression and prenatal use of antidepressants; (iii) maternal demographics factors: age, marital status, education and distance from the hospital; and (iv) pregnancy factors: type of delivery, offspring order and multiple births. Factors were entered in the above-mentioned order, in separate blocks and a stepwise fashion into hierarchical linear regression models with the PSS:NICU stress scores (total scores and scores of each subscale) as outcome variables. Infant factors were entered first based on the larger impact of these factors over maternal factors in predicting stress level in NICU mothers [11]. In addition, the association between PSS:NICU stress scores and EPDS scores was tested using Pearson's correlations. Results were considered significant at $p < 0.05$.

Results

Maternal stress and depression scores

Overall, elevated levels of stress (mean PSS:NICU $= 2.99 \pm 0.85$) and depressive symptoms (mean EPDS scores $= 7.90 \pm 4.36$) were observed within 3.24 ± 1.58 d postpartum. Fifty-two percent of mothers reported elevated levels of overall stress (PSS:NICU ≥ 3) and 38% of mothers displayed depressive symptoms (EPDS ≥ 10).

Maternal stress scores: comparison between subscales

A multivariate analysis of variance revealed significant differences between the three PSS:NICU subscales (F(2, 83) $= 85.95$, $p < 0.001$). As show in Figure 1, stress related to alterations in parental role ($M = 3.61$, $SD = 0.97$) was significantly higher than stress related to infant's behavior and appearance ($M = 2.92$, $SD = 1.10$) and NICU sights and sounds ($M = 2.20$, $SD = 0.84$) (F(1, 89) $= 39.82.83$, $p < 0.001$ and F(1, 89) $= 173.57$, $p < 0.001$, respectively). Stress related to infant's behavior and appearance was significantly higher than stress related to NICU sights and sounds (F(1, 89) $= 38.98$, $p < 0.001$).
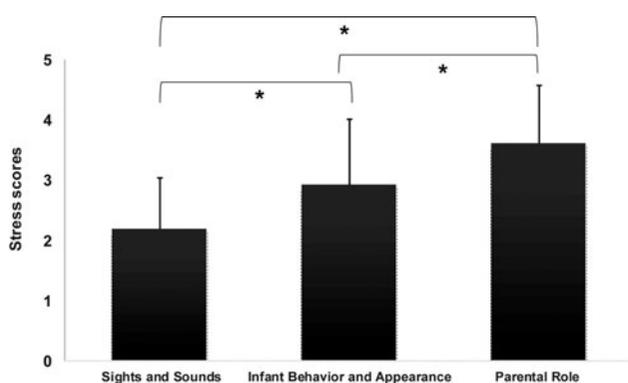

Figure 1. Mean maternal stress scores are shown for each of the three PSS:NICU subscales. Mothers reported highest stress related to alterations in their parental role ($p < 0.001$), followed by stress related to the behavior and appearance of their infants ($p < 0.001$), and to the least extent, stress-related NICU sights and sounds ($p < 0.001$). Error bars represent standard deviation of the mean.

Table 2. Risk factors for maternal stress.

	β	95% CI	p
Sights and sounds			
Marital status	-0.40	-1.60 to -0.14	0.02
Parental role			
Distance from the hospital	0.42	0.008 to 0.041	0.003

Predictors of stress

Significant predictors of maternal stress are given in Table 2. Marital status ($\beta = -0.40$, $p = 0.02$) was found to be a significant predictor for increased maternal stress related to NICU sights and sounds, accounting for 27% of the variance ($R^2 = 0.275$, $p = 0.02$). A follow-up t-test revealed significantly higher stress scores on the sights and sounds subscale in married versus single mothers ($t(80) = 3.00$, $p = 0.004$).

Distance from the hospital was found to be a significant predictor of stress related to parental role ($\beta = 0.42$, $p = 0.003$), accounting for 33% of the variance ($R^2 = 0.328$, $p = 0.03$). A significant positive correlation was found between distance from the hospital (miles) and stress related to parental role ($r = 0.20$, $p = 0.04$).

Association between maternal stress and depression

As shown in Figure 2, maternal depression was positively correlated with overall maternal stress ($r = 0.55$, $p = 0.001$), stress related to parental role ($r = 0.47$, $p = 0.007$) and stress related to infant behavior and appearance ($r = 0.57$, $p = 0.001$), but not with stress related to NICU sights and sounds ($r = 0.32$, $p = 0.08$).

Discussion

This study aimed to identify maternal and infant factors associated with increased levels of stress in mothers of premature infants upon admission to the NICU. Analysis was focused on stressors arising from the physical and psychosocial environment of the NICU across three main domains: parental role, infant's behavior and appearance, and the sights and sounds in the NICU environment. The findings showed that, overall, a majority of mothers experienced high levels of stress within only several days of their infants' hospitalization. Higher stress scores were positively associated with higher depressive symptoms. Living long distance from the hospital and married marital status were significant predictors of stress.

In this study, maternal stress was assessed soon after NICU admission. This design allowed us to capture mothers at a critically fragile time-point within a consistently small timeframe post-partum (3.2 ± 1.6 d). Previous studies, however, have assessed maternal stress within a largely variable time frame, ranging from 1 to 30 d [12,15], 1–84 d [13] and 1–155 d [11] after birth. Such variability in the time of assessment may challenge the generalizability of the results and limit comparison between studies.

Our results showed that the initial stress levels measured upon NICU admission are not influenced by infant factors, such as, birth GA, birth weight, Apgar 5′ scores and status of
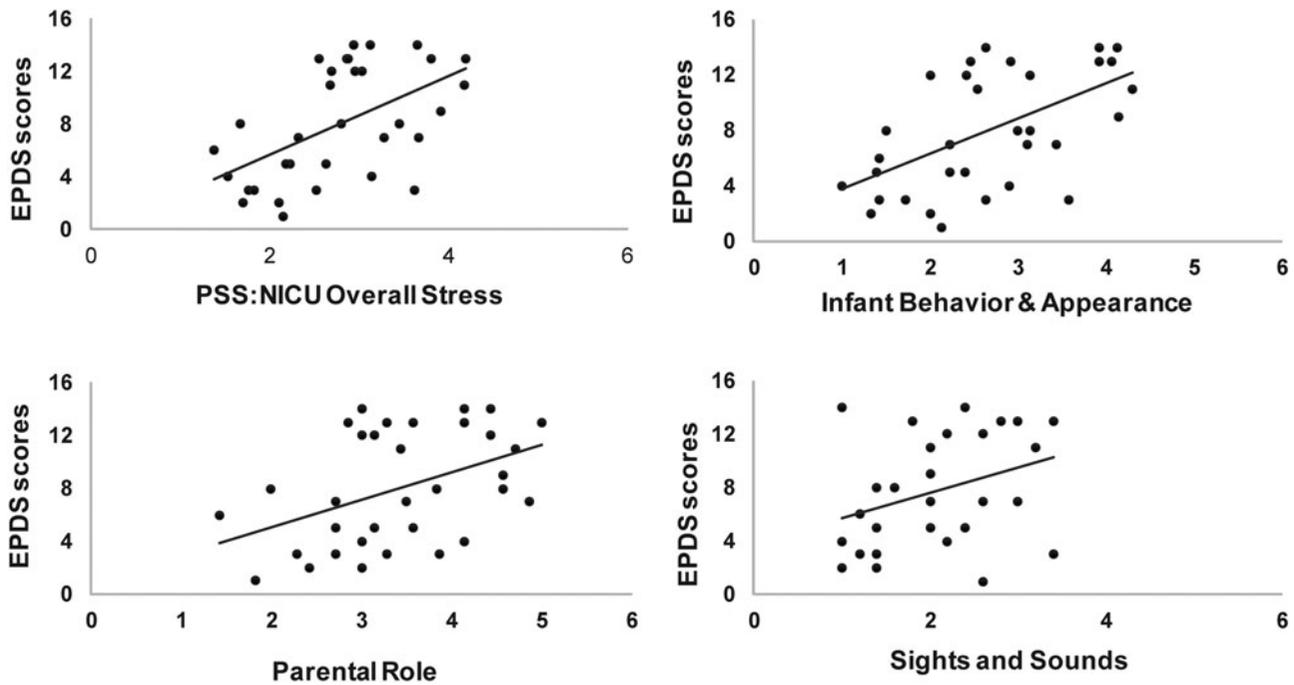
Figure 2. Maternal depression (EDPS) scores were positively correlated with overall maternal stress ($r = 0.55$, $p = 0.001$), stress related to parental role ($r = 0.47$, $p = 0.007$) and stress related to infant behavior and appearance ($r = 0.57$, $p = 0.001$), but not with stress related to NICU sights and sounds ($r = 0.32$, $p = 0.08$).

respiratory support. The time window of maternal stress assessment used in this study is a critical factor in explaining these results. The health status of the infant might vary on a day-to-day basis and might affect maternal stress to different degrees at different time points during their infant's hospitalization. Stress levels upon NICU admission can therefore decrease or increase toward NICU discharge as mothers gain a better understanding of the magnitude of their infant's health status and the clinical implications of his/her prematurity [23]. It is therefore important to consider the timing of maternal stress assessment to draw meaningful conclusions about these findings. It appears that the traumatic experience of the preterm birth and the physical separation from the newborn upon NICU admission is sufficient to generate substantially elevated levels of stress before factors related to their infant's illness severity may come into play. This resonates with previous studies showing that parental trauma in the NICU is less related to infant characteristics than it is to alterations in their parental role [22].

Distance from the hospital was a significant predictor for increased stress related to alterations in parental role. An enabling factor, such as geographic distance from the hospital, has already been shown to significantly limit the visiting frequency of NICU parents [24]. Mothers who reside at a considerable distance from the hospital are more likely to be concerned about the feasibility and frequency of their NICU visits as well as the financial and psychosocial distresses associated with it. This can intensify the emotional vulnerability associated with the physical separation between the mother and the infant, which in turn, may impair maternal–infant attachment, suppress parental behavior, and increase stress. Thus, mothers living long distance from the NICU might benefit from receiving additional support from social services. To the extent possible, transfer opportunities

to a hospital closer to home should be more frequently considered.

The finding that married marital status was a significant risk factor for stress is consistent with previous studies reporting that married mothers in the NICU show higher levels of stress [11] and depression [21] than unmarried mothers. These results are also in keeping with research suggesting that the experience of premature delivery may potentiate stress in married couples [21,25]. The possibility exists that stressors related to the marriage dynamics and the integrity of the family after a premature birth greatly impact the perception of stress among married mothers. However, the reason why marital status was specifically associated with stress related to NICU sights and sounds (but not with parental role or infant behavior and appearance) remains unclear.

Interestingly, high levels of maternal stress were strongly correlated ($r = 0.50$) with symptoms of depression as measured by the EPDS upon NICU admission, and over a third of mothers reported experiencing significant levels of depressive symptoms. These results fit well with previous studies showing higher prevalence of depressive symptoms in mothers of preterm versus full-term infants [26] (for a review, see [6]). More broadly, the results of this study suggest that the PSS:NICU may be used to red-flag mothers at risk for postnatal depression. Early screening is particularly important given that postnatal depression is associated with alterations in mother–infant attachment and increased risk of poor cognitive, behavioral and emotional outcomes in the infant [7,8]. Thus, interventions to reduce stress and promote emotional resilience for mothers of preterm infants should be offered routinely in all NICUs. Interventions aimed to provide NICU mothers with greater social support and increased maternal competence have yielded successful

results in reducing stress, anxiety and depression [27,28]. However, although other therapeutic approaches, such as Guided Family-Centered Care, have shown to improve communication between parents and caregivers in the NICU, they had no effect on reducing maternal stress [29], indicating room for improvement.

In reviewing the results of this study in the context of the previous literature, it is important to point out that 60% of the mothers in our study population had at least college-level education (Table 1). This highly educated group of mother may not be well representative of most NICU parent population and thus results should be carefully generalized. One should also bear in mind that the early postpartum period (during which the study was performed) is associated with deterioration of neurologic and cognitive function [30], which in and of itself, could have influenced the mothers' perception of stress.

Finally, in consideration of the findings, it should be mentioned that this study was conducted in an open-bay NICU. Therefore, the results presented in this study might not generalize to other units with a private-suite design. It is possible that the social culture in open-bay units is more supportive due to parent-to-parent interactions, which may help in reducing stress levels. On the other hand, the increased privacy of individual rooms might make mothers feel more comfortable when spending time with their infant and consequently reduce maternal stress. Future research is necessary to establish how differences in the NICU design influence maternal stress levels.

Conclusion

Elevated levels of stress and depressive symptoms are already present in mothers of preterm infants upon NICU admission. Psychological distress related to alterations in parental role is the most significant source of stress among NICU mothers. These stressors appear to increase the further away the mother lives from the hospital. Married mothers might be at increased risk for stress, although future studies are still needed to elucidate this finding. The results of this study underscore the importance of early identification and proper treatment of maternal stress soon after a preterm birth. Future research should monitor more closely how maternal stress changes throughout the infant's NICU stay. This information can be used to design effective coping strategies for mothers at different time points during their infant's hospitalization.

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Declaration of interest

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