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ORIGINAL ARTICLE

Depressive symptoms in mothers of preterm infants before and during COVID-19 restrictions in neonatal intensive care units

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Abstract

Aim: Little is known about the specific restriction measures used in intensive care units (NICUs) during the COVID-19 pandemic and their impact on parental well-being. Hence, this study aimed to assess the association between restriction measures and mothers' post-partum depressive symptoms.

Methods: This comparative cohort study included mothers who gave birth before 35 weeks of gestation in Estonia. The outcome measure was mothers' post-partum depressive symptoms at the time of infant discharge, evaluated using the Edinburgh Postnatal Depression Scale (EPDS). In addition to the pandemic itself, the number of restriction measures in the NICUs was analysed as a potential explanatory factor for depressive symptoms.

Results: The study included 55 mothers before the pandemic in 2018–2019 and 54 mothers during the COVID-19 pandemic in 2021. No significant difference was found in the median EPDS scores between the cohorts: 7.0 [interquartile range (IQR): 4.0–12.0] and 8.0 (IQR: 5.0–12.8) respectively. The number of restriction measures was not associated with mothers' EPDS scores in either unadjusted or adjusted models.

Conclusion: The COVID-19 pandemic or the number of restriction measures used in Estonian NICUs did not associate with mothers' post = partum depressive symptoms.

KEYWORDS
depression, family centred care, pandemic, preterm birth, visiting policies

1 | INTRODUCTION

Post-partum depression is a common mental health problem among post-partum mothers. It may have adverse effects on mother–infant interaction and well-being of infants.[1] According to meta-analyses, the overall prevalence of post-partum depression is about 17%.[2,3] The significant predictors of maternal post-partum depression are a past history of mental illness, poor socioeconomic status, poor social support, poor marital relationships and stressful life events.[1,4,5]

Traditionally, preterm birth leads to physical and emotional separation between the parents and infant due to the infant's admission to a neonatal intensive care unit (NICU). The mothers' limited

Abbreviations: EPDS, Edinburgh Postnatal Depression Scale; IQR, interquartile range; NICU, neonatal intensive care unit.

presence and participation in the caretaking of preterm infants have been shown to compromise the mothers' psychological well-being.[6,7] A meta-analysis showed that the odds of post-partum depression in mothers was 1.79 times higher after preterm birth than full-term birth.[8]

Today, many NICUs provide family-centred care, allowing parents to access NICUs 24/7 and supporting parents' participation in the care of their infant. Family-centred interventions have been shown to be associated with decreased post-partum depressive symptoms in mothers of preterm infants. For example, the Close Collaboration with Parents intervention was associated with the reduction of depressive symptoms, as evaluated using the Edinburgh Postnatal Depression Scale (EPDS). The reduction observed was 42% at 4–6 months of corrected age[9] and 37% at 24 months of corrected age.[10] The Family Nurture Intervention reduced the proportion of mothers with possible clinical depression at 4 months of corrected age by 15%.[11] Family-centred care is considered a state-of-the-art approach in neonatal care because of its demonstrated benefits not only for mothers but also for infants.[12]

However, COVID-19 caused a worldwide reduction in parents' access to NICUs and participation in the care of their infants. When the pandemic started in March 2020, most NICUs were forced to set up restrictions in accordance with the governmental and hospital policies.[13,14] Many of these measures limited parental presence and involvement in the caretaking of their infants. Few previous studies have investigated whether the COVID-19 pandemic was associated with the increase in post-partum depressive symptoms in mothers in NICUs. Three studies in Belgium, Switzerland and Italy found a slightly higher mean score for depression, assessed using the EPDS, during the pandemic compared to before. However, none of the studies showed a statistically significant difference.[15–17] Only the Belgian study revealed a significantly higher proportion of mothers exceeding the cut-off for possible clinical depression during the pandemic than before.[15] In addition, all three were single-centre studies and did not consider potential confounders in their analyses. Furthermore, none of them focused on the effect of the specific restriction measures implemented in NICUs.

Thus, the effect of the COVID-19 pandemic on the post-partum depressive symptoms of mothers remains unclear. In this study, we evaluated the association between the COVID-19 pandemic and post-partum depressive symptoms in mothers after preterm birth. In addition, we evaluated the association between the use of NICU restriction measures and depressive symptoms.

Key notes

- There are no studies about the impact of the COVID-19 restriction measures used during neonatal care on mothers' depressive symptoms.
- The number of COVID-19 restriction measures in neonatal intensive care units in Estonia was not associated with post-partum depressive symptoms in mothers of preterm infants.
- The use of hospital visiting policies and their impact on maternal well-being should be studied more widely.

2 | METHODS

2.1 | Study design and protocols

This comparative cohort study used two preterm cohorts selected from Estonia before and during the COVID-19 pandemic. The pre-pandemic cohort was recruited between January 2018 and May 2019 for the 2nd International Closeness Survey.[18] This was a prospective cohort study conducted among 23 NICUs from 15 countries in Europe, North America and Oceania, without any intervention. No unit or country-specific analyses have been reported. The pandemic cohort was recruited between 23 March and 23 July 2021. This cohort was a part of the Close Collaboration with Parents Intervention Effectiveness Study in Estonia. The study cohorts included all seven Level III and Level II NICUs in Estonia, where the care of all infants born below 35 weeks of gestation is centralised. These NICUs were located in four hospitals in the two largest cities in Estonia. Out of the seven NICUs, two were not included in both cohorts. One of the Level II NICUs was only included in the pre-pandemic cohort, while another one was only included in the pandemic cohort. These two NICUs were comparable, as they both operated in the same urban region and had similar sizes, patient structures and levels of neonatal care.

Ethical approval was obtained separately for each study. The study permission of the 2nd International Closeness Survey (pre-pandemic cohort) was obtained from the Hospital District of Southwest Finland before the pandemic (registration number T08/011/18), whereas that of the Close Collaboration with Parents Intervention Study (pandemic cohort) was obtained from the Research Ethics Committee of the University of Tartu during the pandemic (approval number 333/T-21). Parents received written and verbal information about the study and had time to consider their participation. Those who agreed signed informed consent forms.

2.2 | Participants

The inclusion and exclusion criteria for both studies were similar but not identical. In the pre-pandemic cohort recruitment, mothers who gave birth before 35 weeks of gestation were eligible. Families were excluded if the expected duration of hospitalisation was less than 3 days, the infants were triplets, the parents could not speak fluent Estonian or Russian or the infant's condition was critical and survival uncertain. Of 130 eligible mothers, 61 were enrolled in the study (Figure 2).

In the pandemic cohort recruitment, mothers whose neonate was hospitalised during the first 28 days of life were eligible,

regardless of the gestational age. Of those, mothers who gave birth before 35 weeks of gestation were selected for this study. Families were excluded if the expected duration of hospitalisation was less than 3 days or if the mother could not speak fluent Estonian, Russian or English. Of 91 eligible mothers, 59 were enrolled in the study (Figure 2). The mothers who gave birth before 35 weeks of gestation were selected from the cohorts for this study. Hereafter, the group selected before the pandemic is called the pre-COVID group and during the pandemic—the COVID group.

2.3 | Measures

Depressive symptoms were measured using the EPDS when the infant was discharged from the NICU. The EPDS has proven itself a valid method to measure postnatal depressive symptoms.[19] It contains 10 questions, and each item is scored from 0 to 3. The total score ranges from 0 to 30; a higher score indicates more severe depressive symptoms. The mean total score of EPDS was used as the primary outcome of this study. Additionally, as a secondary outcome, the incidence of possible clinical depression among mothers was estimated using the most commonly used total EPDS cut-off score of >12,[19,20] and compared between the groups. Those parents who exceeded the EPDS clinical cut-off score of 12 were contacted and offered support. The Cronbach's alpha was 0.88 in the Pre-COVID group and 0.80 in the COVID group.

These outcomes were also compared between infants exposed to a higher and lower number of restriction measures in NICUs. Each NICU recorded the details of its restriction measures and changes in them throughout the data collection period, which is summarised in Figure 1. Participating NICUs during the COVID-19 pandemic were classified into two groups based on the number of restriction measures. The reported restriction measures targeted to the parents related to mothers' overnight stay, mothers' visit to NICU, fathers' overnight stay, fathers' visit to NICU and both parents at the same time in NICU. If an item was permitted with some limitations, it was counted as 0.5: for example, parents needed a COVID-19-negative virus test certificate to visit their infant in NICUs. Then, the infants and their mothers in the COVID group were divided into two subgroups according to their degree of exposure to the NICU restriction measures: the high-restriction group and the mild-restriction group (Figure 2). They were classified into the high-restriction group if, for more than 50% of the infant's admission period, they were exposed to NICUs with two or more restriction measures. All others were classified into the mild-restriction group. Those in the Pre-COVID group were classified into the baseline group, although some NICUs had certain restriction measures even before the COVID-19 pandemic.

Background information was collected from medical records or from parents using a questionnaire. Twins were treated differently in the two studies. The infant born first was chosen for the Pre-COVID group. In the COVID group, the twin with the longer length of stay was chosen, or the parents chose one if the twins were discharged home on the same day.

2.4 | Statistics

Comparisons were made between the Pre-COVID and the COVID groups. The same comparisons were also made between the high-, mild-restriction and baseline groups.

The difference in the EPDS score was analysed using Wilcoxon's rank-sum test and the Kruskal–Wallis test. The difference in the

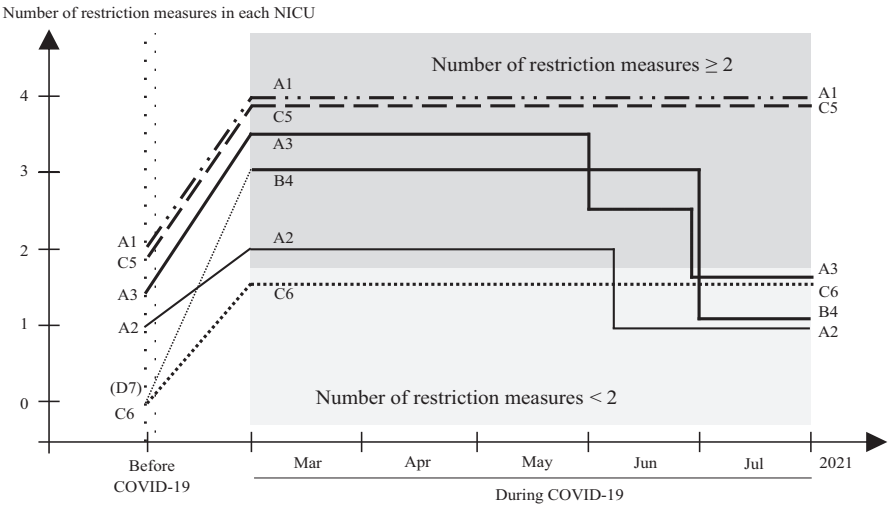

FIGURE 1 The number of restriction measures and their changes over time in each NICU (A1–D7). The same alphabet indicates the NICU in the same hospital. The NICU B4 was included only during the COVID-19 pandemic, and the NICU D7 was included before COVID-19, which were comparable as noted in the Methods section. The included restriction measures were targeted to: (1) mothers' overnight stay, (2) mothers' visit to NICU, (3) fathers' overnight stay, (4) fathers' visit to NICU and (5) both parents at the same time in NICU. If an item was permitted with some limitations, it was counted as 0.5 (e.g. parents needed a COVID-19-negative certificate to visit their infant in NICUs). NICU, neonatal intensive care unit.

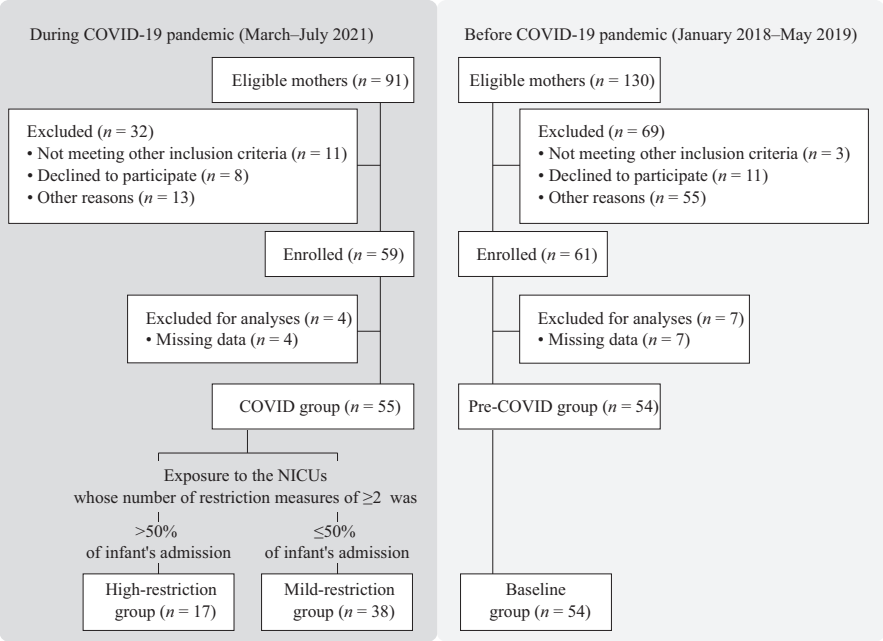

FIGURE 2 Patient flow diagram.

proportions of mothers with a total EPDS score of >12 was analysed using Fisher's exact test. Potential confounders were taken into consideration using a multiple linear regression model and a logistic regression model. Factors included in these models were infants' gestational age at birth, multiple births, mothers' age, education and the number of children at home. Mothers' smoking status and parents' marital relationship were excluded from the adjusted model to maintain its reliability because very few or no mothers had smoked or had been a single parent in both groups. The time from birth was also excluded because of its collinearity with gestational age. Analysis was conducted using R, version 4.1.2 with the R packages of tidyverse,[21] version 1.3.1, epitools,[22] version 0.5-10.1, RVAideMemoire,[23] version 0.9-81, and dplyr,[24] version 1.0.8. The analyses performed were two-tailed, and p <0.05 were considered statistically significant.

3 | RESULTS

A total of 109 mothers were eligible for the analyses: 54 in the Pre-COVID group and 55 in the COVID group (Figure 2). From the data of all eligible mothers, the median age was 32 years (interquartile range [IQR]: 28–36). Additionally, 3% of them were single parents, and 49% had higher education. These characteristics were comparable to those of the Estonian population, as summarised by the National Institute for Health Development in Estonia. The background characteristics of mothers and their infants in both groups were comparable, except for the earlier gestational age and smaller weight at birth in the COVID group than in the Pre-COVID group (Table 1).

Table 2 summarises the results of the analyses comparing the total EPDS scores assessed at infants' discharge between the COVID and the Pre-COVID groups. The median EPDS score was lower in the COVID group than in the Pre-COVID group, but the difference was not statistically significant between the groups. The adjusted mean total EPDS score showed no significant difference. The proportion of mothers with possible clinical depression (EPDS >12) was 21.8% in the COVID group and 25.9% in the Pre-COVID group. The difference was not statistically significant. The adjusted odds of possible clinical depression were not significantly different between the two groups either.

Figure 1 summarises the number of restriction measures in each unit. We classified 17 mothers into the high-restriction group, 28 into the mild-restriction group and 54 into the baseline group (Figure 2). More mothers were first-time mothers, fewer mothers had higher education and fewer infants were boys in the high-restriction group than in the other two groups. Infants in the mild-restriction group were born earlier with smaller birth weights than those in the other two groups (Table 1).

Table 3 summarises the results of the analyses comparing the total EPDS scores assessed at infants' discharge between three restriction groups: the high-restriction group, mild-restriction group and baseline group. The median EPDS scores were 9.0 (IQR: 3.0–11.0) in the high, 7.0 (IQR: 4.0–12.0) in the mild and 8.0 (IQR: 5.0–12.8) in the baseline group, with no significant differences. The adjusted mean total EPDS score was lowest in the mild-restriction group, followed by the high-restriction and baseline groups. No comparison yielded a significant difference. The proportions of mothers with possible clinical depression (EPDS >12) were 17.6%, 23.7% and 25.9% in the high-, mild- and baseline groups, respectively, with no significant difference between the three groups. The adjusted odds ratio was not significantly different between any of the groups.

TABLE 1 Demographic factors of the mothers and infants.

	COVID group ($n = 55$)			Pre-COVID group ($n = 54$)
	Total ($n = 55$)	High-restriction group ($n = 17$)	Mild-restriction group ($n = 38$)	Baseline group ($n = 54$)
Mother				
Age, median (IQR), years	32 (28, 36)	31 (27, 34)	32 (29, 36)	32 (28, 37)
Vaginal delivery, *n* (%)	21 (38)	7 (41.2)	14 (36.8)	26 (48.1)
Singleton, *n* (%)	43 (78)	13 (76.5)	30 (78.9)	41 (75.9)
First child, *n* (%)	24 (44)	10 (58.8)	14 (37.8)	16 (34.0)
Smoking, *n* (%)	5 (9)	1 (5.9)	4 (10.5)	2 (3.7)
Single parent, *n* (%)	1 (2)	0 (0)	1 (2.6)	2 (3.7)
Higher education, *n* (%)	27 (50)	6 (35.3)	21 (56.8)	25 (48.1)
Infant				
Male sex, *n* (%)	29 (53)	5 (29.4)	21 (55.3)	27 (50.0)
Gestational age, median (IQR), week	30.6 (28.6, 33.2)	33.4 (32.4, 34.1)	29.6 (28.6, 31.8)	32.2 (29.6, 33.9)
Birth weight, median (IQR), g	1492 (1030,1999)	2040 (1870, 2345)	1274 (874, 1650)	1733 (1346, 2160)

Abbreviation: IQR, interquartile range.

TABLE 2 Regression analyses of the differences in the mothers' depressive symptoms at discharge of the infant in the COVID and Pre-COVID group.

	COVID ($n = 55$)	Pre-COVID ($n = 54$)	Unadjusted		Adjusted	
	Mdn (IQR)	Mdn (IQR)	Z[a]	p	MD (95% CI)	p
EPDS	7.0 (4.0, 12.0)	8.0 (5.0, 12.8)	0.72	0.46	−2.0 (−4.00, 0.10)	0.062
	n (%)	*n* (%)	OR (95% CI)	p	OR (95% CI)	p
EPDS >12	12 (21.8)	14 (25.9)	0.80 (0.30, 2.11)	0.66	0.50 (0.18, 1.31)	0.16

Abbreviations: 95% CI, 95% confidence interval; EPDS, Edinburgh Postnatal Depression Scale; IQR, interquartile range; MD, mean difference; Mdn, median; OR, odds ratio.

[a]Z is the effect size of Wilcoxon's rank-sum test.

4 | DISCUSSION

This multicentre comparison study found no significant association between the COVID-19 pandemic and mothers' post-partum depressive symptoms after preterm birth. The adjusted model also showed no association. In addition, the number of restriction measures in the NICUs did not affect mothers' post-partum depressive symptoms during the COVID-19 pandemic even after adjusting the potential confounders.

To the best of our knowledge, only three previous studies have evaluated the effect of the COVID-19 pandemic on mothers' post-partum depressive symptoms in NICUs.[15–17] All were single-centre studies, whereas this study used six NICUs for each data collection phase, which covered most preterm births in Estonia. A study from Belgium found significantly higher adjusted odds of possible clinical depression during the COVID-19 pandemic than before.[15] The Belgian study included mothers of infants born before 32 weeks of gestation, whereas this study included mothers of infants born before 35 weeks of gestation. Furthermore, the Belgian study collected its data during the first lockdown and at 3–6 months after discharge. This may have impacted mothers' social isolation and loneliness, which are known risk factors for post-partum depression.[25] On the other hand, the results of the other two studies were in line with our findings in showing no significant associations. Our results were also consistent with those of a meta-analysis of mothers of full-term infants, which found no significant difference in total EPDS scores between those during the COVID-19 pandemic versus before.[26]

This study was the first, to the best of our knowledge, to document the restriction measures during the COVID-19 pandemic. Even during the COVID-19 pandemic, many NICUs in Estonia permitted overnight stays or visits by mothers. The restrictions seemed milder than in a previous report.[14] This may be because all NICUs permitting overnight stays by mothers consisted of single-family rooms, which enabled mothers to reduce contact with other families or people outside the hospital. On the other hand, overnight stays or visits by fathers were more severely restricted than those by mothers, especially at the beginning of the period. This might have been

TABLE 3 Regression analyses of the differences in the mothers' depressive symptoms at discharge of the infant by the degree of exposure to the COVID-19 restrictions.

	Unadjusted				Adjusted					
	High ($n=17$)	Mild ($n=38$)	Baseline ($n=54$)		High vs Baseline		Mild vs Baseline		High vs Mild	
	Mdn (IQR)	Mdn (IQR)	Mdn (IQR)	p	MD (95% CI)	p	MD (95% CI)	p	MD (95% CI)	p
EPDS	9.0 (3.0, 11.0)	7.0 (4.0, 12.0)	8.0 (5.0, 12.8)	0.74	−1.6 (−4.5, 1.3)	0.28	−2.1 (−4.5, 0.2)	0.071	0.6 (−2.6, 3.7)	0.73
	n (%)	n (%)	n (%)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
EPDS >12	3 (17.6)	9 (23.7)	14 (25.9)	0.87	0.38 (0.1, 1.5)	0.20	0.6 (0.2, 1.7)	0.32	0.7 (0.1, 3.2)	0.63

Abbreviations: 95% CI, 95% confidence interval; Baseline, Baseline group; EPDS, Edinburgh Postnatal Depression Scale; High, High-restriction group; IQR, interquartile range; MD, mean difference; Mdn, median; Mild, Mild-restriction group; OR, odds ratio.

because fathers frequently went out of the hospital to go to work, go shopping or take care of older children, for example, and were therefore at higher risk of infection than mothers. Other visitors, including siblings and grandparents, were not allowed to visit, which is in line with the previous report.[14]

Surprisingly, the number of the restriction measures in the NICUs was not associated with mothers' post-partum depressive symptoms. However, our results do not mean that COVID-19 restriction measures in NICUs have no effect on maternal mental well-being. First, it may be that depression was not a sensitive measure for the effect of the pandemic. A systematic review and meta-analysis showed that the COVID-19 pandemic significantly increased the risk of anxiety among women during the perinatal period but not the risk of depression.[26] Secondly, the usual parental benefits, such as parental leave and financial support up to 18 months after the child's birth, remained unchanged during the COVID-19 pandemic. This may have helped the mothers cope with the stress of the pandemic. Thirdly, and maybe most importantly, NICU care in Estonia is known to be family-centred care,[6] and this was also the case during the COVID-19 pandemic. Many NICUs in Estonia have been implementing rooming-in as part of their common care culture for a long time. In other words, Estonian parents usually stay with their infant in the same room and participate in the caretaking even if the infant requires care in NICUs.[6] This rooming-in, or overnight stays by parents in the NICU, was allowed in many NICUs in Estonia even during the COVID-19 pandemic. In addition, during this study, which spanned pre-COVID and COVID periods, one unit moved to a renovated NICU with single-family rooms. Furthermore, some NICUs offered additional psychological and emotional support to parents by healthcare staff during the COVID-19 pandemic, which was shown to act as a protective factor against depression during the pandemic.[27] These supportive systems, the possibility of rooming-in and support from the healthcare staff may have maintained mothers' resilience during the COVID-19 pandemic.

This study had some limitations. First, the number of mothers may have been too small to detect group differences in EPDS scores, especially in the comparison of the NICU restriction measures. Second, based on our results, we cannot exclude the possibility that restriction measures are associated with the onset of depressive symptoms after the infant is discharged home. This is because the risk of maternal post-partum depression remains high during the first 6 months after preterm delivery.[8,28] Third, the two data collection phases used different NICU combinations, which prevented us from comparing cohorts from the same hospitals. Fourth, in our analyses, we only considered the number of restriction measures, not how they were experienced by the mothers. Lastly, restriction measures in NICUs were strongly associated with the severity of the COVID-19 pandemic. In addition, some NICUs had some restriction measures in place even before the COVID-19 pandemic. Thus, it is impossible to confirm the pure effect of the restriction measures in NICUs without a comparison group for the same period during the COVID-19 pandemic.

5 | CONCLUSION

This study showed no significant association between COVID-19 restriction measures and post-partum depressive symptoms in mothers of preterm infants in NICUs. The family-centred care culture, the design of single-family rooms and the support provided by healthcare staff may have protected mothers from an increase in depressive symptoms during the COVID-19 pandemic in Estonian NICUs. Further studies are warranted to understand the negative impact of NICU restriction measures and visiting limitations on maternal well-being. Even more importantly, studies are needed to understand how to best support parents' resilience in NICUs during times when certain restrictions are necessary.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to declare.

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