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ORIGINAL RESEARCH

What Influences Maternal Stress in The NICU Among Mothers of Preterm Infants?

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Purpose: To assess the levels of stress and anxiety in mothers of preterm infants across various gestational ages (GA) and identify GA-specific factors contributing to maternal stress.

Patients and Methods: Stress and worry were measured in 146 mothers of infants ≤32 weeks GA and 101 mothers >32 weeks GA using the Parental Stressor Scale: Neonatal Intensive Care Unit (PSS: NICU) and Worry Index (WI) questionnaires. PSS: NICU questions were distributed across the following subscales: Sights and Sounds (subscale1 (S1), Infant Appearance and Behavior (S2), and Parental Role Alteration (S3).

Results: Mothers of infants ≤32 weeks GA had higher total PSS: NICU and WI scores than those >32 weeks' GA (p=0.005 and p=0.023, respectively). S3 was the most stressful subscale in both groups, followed by S2. The factors associated with higher stress in mothers of extremely/very preterm infants: seizures (p=0.022 for total PSS:NICU, p=0.030 for S2, and p=0.008 for S3), infection (p=0.045 for total PSS:NICU, p=0.039 for S2), depression (p=0.049 for total PSS:NICU), cesarean section (p=0.024 for S3), and twins (p=0.048 for S3). Higher WI was associated with lower education and C-section (p=0.038 and p=0.000, respectively). The factors associated with higher stress in the mothers of moderate/late preterm neonates: unemployment (p=0.043 for S3), vaginal delivery (p=0.035 for total PSS:NICU, p=0.048 for S3), and older children (p=0.042 for S3). Higher WI was associated with lower educational level (p=0.036), unemployment (p=0.035), depression (p=0.039), and seizures (p=0.021).

Conclusion: NICU-related stress and WI levels were higher in mothers of infants with GA ≤32 weeks and were correlated with GA. In extremely/very preterm infants, higher maternal stress was linked to seizures, infection, C-section, twins, low education, and maternal depression. In moderate/late preterm neonates, stress was associated with unemployment, vaginal delivery, and having older children. Parental role alteration was the main stressor in all groups.

Keywords: maternal stress, PSS: NICU, worry index, neonatal intensive care unit, preterm infants

Introduction

The treatment of preterm infants in the neonatal intensive care unit (NICU) is stressful for both the infants and parents. Mothers of premature neonates experience significant psychological distress, as evidenced by increased levels of depression, stress, anxiety, and post-traumatic stress symptoms, which are often interrelated.[1,2] Maternal stress related to NICU admission is a worldwide healthcare issue, both in high-income and low–middle-income countries.[3,4] Preterm births are often unexpected and can lead to concerns about the health and well-being of the infant.[5] Uncertainty about the child's survival, future health and quality of life, a sense of loss of control over the event, and the need for physical and emotional separation are the causes of stress, anxiety, worry, fear and deterioration of mental health in parents.[6]

Parents are also concerned about threats to the child's life, the unstable condition of the infant with extensive medical equipment, his/her suffering, and pain. Mothers may feel anxiety due to the alteration of their parental role in the NICU: inability to freely contact the baby, independently feed, change clothes and fully care for the child.[7]

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Most mothers of preterm neonates are initially in a state of shock during the first few days after their infant's admission to the NICU and may exhibit significant symptoms of depression, anxiety, and worry as early as the second week of the infant's stay in the intensive care unit [8]. Although psychological distress may decrease during the NICU stay, symptoms may recur before discharge from the unit and include increased parental perception of the infant's vulnerability and anxiety. Maternal psychological state may also change shortly after a sudden change in the infant's clinical condition or a new prognosis for the baby's health.[8,9]

Maternal stress and anxiety are often neglected by healthcare professionals because the focus is on treating and caring for sick newborns.[10] However, neonatologists are increasingly calling for early screening for maternal psychological distress in the intensive care units.[11] Immediate action should be taken to screen mothers in the NICU for depression, anxiety and stress.[4] Maternal NICU-related stress not only compromises the mental health of parents in early parenthood,[12] but also disturbs their bonding and relationship with child and may negatively impact infant's development.[13] There is an important link between maternal mental health and the neurological status of the infant, as well as his/her social, behavioral, and cognitive development.[14,15] The bond between mother and infant, which is believed to lay the foundation for a long-term relationship between child and parents, does not develop because the newborn remains separated in the NICU.[10] The smaller the gestational age (GA) of the child, the longer the infant stays in the intensive care unit and has a higher risk of complications.[16]

The purpose of the study was to assess the levels of stress and anxiety in mothers of preterm infants across various gestational ages (GA), and to identify GA-specific factors contributing to maternal stress.

Material and Methods

This observational, cross-sectional study was conducted at NICUs of five regional perinatal centers in Ukraine. Each center is a level III NICU with 6–12 beds, serving an average annual birth cohort of 3.000–5.000 infants. Maternal stress was assessed in 247 mothers of preterm infants using the questionnaire Parental Stressor Scale: NICU (PSS: NICU). Preterm birth, defined as delivery before 37 weeks of gestation.[17] There were 146 mothers of infants with (GA) ≤ 32 weeks (extremely and very preterm infants) and 101 mothers of infants with GA > 32 weeks (moderately and late preterm infants). PSS: NICU questionnaire included 26 items distributed in the following subscales: Sights and Sounds of NICU – subscale 1 (S1) – 5 items, Infant Appearance and Behavior – S2 – 14 items, and Parental Role Alteration – S3 – 7 items. On a Likert scale, mothers were asked to rate how stressful the experience described in each item was for them on a scale of 1 to 5. A score of 1 indicated that the factor did not cause any stress, and 5 indicated that it was extremely stressful. No experience (NE) corresponded to a situation that the mother had not previously experienced. Total PSS: NICU scores were calculated according to the author's instructions, using the method of stress occurrence level, which calculated only experienced items. According to the author's recommendations, this method should be used when focusing on parents, as it better captures their experience.[18]

The Worry Index questionnaire was used to measure the degree to which a mother worries about her preterm infant and his or her risk for problems. It included seven areas: medical issues, growth and developmental concerns, disorders, risk of rehospitalization, and sleeping and eating difficulties. Items are rated on a 5-point scale, from "not at all" to "very much".[19]

Before the study began, permission to translate and use the questionnaires was obtained from the author, Prof. Margaret S. Miles, RN, PhD, FAAN, Emeritus Professor at the School of Nursing, University of North Carolina. Linguistic validation was subsequently conducted.

Maternal questionnaires were administered during the infant's hospitalization in the neonatal intensive care unit (NICU), specifically between days 3 and 7 of the NICU stay.

Inclusion Criteria

Preterm delivery, the infant's NICU stay for at least 3 days, the mother visiting the infant in the NICU at least three times, and willingness to participate in the study with signed informed consent.

Exclusion Criteria

A history of maternal alcoholism or use of illicit drugs; psychiatric diseases in mothers; genetic disorders and/or major congenital malformations in the infant; and a short duration of NICU stay (less than 3 days).

Ethics Approval Statement

The ethical committee of I. Horbachevsky Ternopil National Medical University approved the study, and written informed consent was obtained from all participants. The research was conducted in accordance with the Declaration of Helsinki of the World Medical Association.

Statistics

All computations were performed using StatSoft STATISTICA Version 13 (Tulsa, OK, USA). Quantitative data, including PSS: NICU and Worry Index scores are presented as means (M) and standard deviations (SD). For qualitative parameters, absolute and relative frequencies (percentages) were presented. The *t*-test (for two independent groups) and an ANOVA were used to compare numerical data. Correlations were analysed using the Pearson's correlation coefficient. Significance was assumed at $p<0.05$. The required sample size was calculated using G*Power Software sample size calculator.

Results

Recruitment and Randomization

A total of 264 mothers of preterm infants met the eligibility criteria, of whom 247 were ultimately recruited into the study. Seven mothers did not meet the inclusion criteria, and ten mothers declined to participate and did not sign an informed consent form. Thus, 247 mothers – 146 mothers of infants with GA ≤32 weeks (extremely and very preterm infants) and 101 mothers of infants with GA > 32weeks (moderately and late preterm infants) were interviewed.

Maternal and Infant Clinical Characteristics of the Study Groups

The average maternal age was older in mothers of preterm infants with GA ≤ 32 weeks compared to those of infants with GA > 32 weeks (30.6±5,7 vs 29.1±5,3 years, p=0.047). No significant differences were found in the predelivery maternal characteristics between the two groups of mothers, except for urinary tract infections, which occurred significantly more frequently in the medical history of mothers of moderately and late preterm infants (11.9% vs 4.8%, p=0.040).

The maternal social background and history (educational level, employment status, mode of delivery, family history, predelivery assessment etc.) of the two study groups are presented in Table 1.

There were 143 (57.9%) boys and 66 (42.1%) girls. Males significantly predominated among extremely and very preterm infants (88 boys [60.3%] vs 58 girls [39.7%], $p = 0.015$), whereas no significant gender difference was observed among moderately and late preterm infants (55 boys [54.5%] vs 46 girls [45.5%], $p = 0.368$). The average GA for

Table 1 Maternal and Infants' Clinical Characteristics of the Study Groups

Indicator	Statistical Indicator	Preterm Infants with GA ≤ 32 Weeks, n=146	Preterm Infants with GA > 32 Weeks, n=101	p
MATERNAL CHARACTERISTICS				
Maternal age, years	M±SD	30.6±5.7	29.1±5.3	0.046*
Educational level: - higher education - secondary and incomplete secondary education	n (%)	 84 (57.5) 62 (42.5)	 46 (45,5) 55 (54,5)	 0.190 0.195
Employment status: - employed	n (%)	 83 (56.8)	 52 (51.5)	 0.547
Parity - 1 - ≥ 2	n (%)	 58 (39.7) 88 (60.3)	 44 (43.6) 57 (56.4)	 0.692 0.641

(*Continued*)

Table 1 (Continued).

Indicator	Statistical Indicator	Preterm Infants with GA ≤ 32 Weeks, n=146	Preterm Infants with GA > 32 Weeks, n=101	p
Pregnancy - Singleton - Twins	n (%)	130 (89.0) 16 (11.0)	88 (87.1) 13 (12.9)	0.669 0.875
Delivery mode - Vaginal delivery - Caesarean section	n (%)	56 (38.4) 90 (61.6)	36 (35.6) 65 (64.4)	0.786 0.722
PREDELIVERY MATERNAL ASSESSMENT				
Preeclampsia, eclampsia, gestational hypertension	n (%)	33 (22.6)	30 (29.7)	0.208
Gestational diabetes	n (%)	5 (3.4)	3 (3.0)	0.816
Thyroid gland disorders	n (%)	15 (10.3)	6 (5.9)	0.223
Acute respiratory viral infection	n (%)	14 (9.6)	10 (9.9)	0.938
Placental dysfunction	n (%)	59 (40.4)	44 (43.6)	0.616
Anemia	n (%)	35 (24.0)	22 (21.8)	0.687
Urinary tract infection	n (%)	7 (4.8)	12 (11.9)	0.040*
Maternal bleeding	n (%)	27 (18.5)	17 (16.8)	0.731
Chorioamnionitis	n (%)	7 (4.8)	3 (3.0)	0.481
Fetal distress	n (%)	19 (13.0)	23 (22.8)	0.044*
INFANT'S CHARACTERISTICS				
Gender				
Male	n (%)	88 (60.3%)	55 (54.5%)	0.494
Female		58 (39.7%)	46 (45.5%)	0.552
		p=0.015*	p=0.368	
Birth weight, grams	Me [Lq; Uq]	1400.00 [990.00; 1650.00]	1950.00 [1700.00; 2200.00]	0.000*
Birth length, cm	Me [Lq; Uq]	38.00 [35.00; 41.00]	43.00 [42.00; 45.00]	0.000*
Apgar score at 1st min	Me [Lq; Uq]	6.00 [5.00; 7.00]	7.00 [7.00; 7.00]	0.011*
Apgar score at 5th min	Me [Lq; Uq]	7.00 [6.00; 7.00]	7.00 [7.00; 7.00]	0.176
Respiratory distress syndrome	n (%)	120 (82.2)	38 (37.6)	0.000*
Duration of NICU treatment, days	Me [Lq; Uq]	12.0 [6.0; 21.0]	6.00 [4.00; 9.00]	0.000*
Surfactant replacement therapy	n (%)	76 (52.1)	3 (3.0)	0.000*
Neonatal sepsis (infection)	n (%)	67 (45.9)	35 (34.7)	0.078
Necrotizing enterocolitis	n (%)	35 (24.0)	14 (13.9)	0.051
Invasive ventilation	n (%)	69 (47.3)	19 (18.8)	0.000*

(*Continued*)

Table 1 (Continued).

Indicator	Statistical Indicator	Preterm Infants with GA ≤ 32 Weeks, n=146	Preterm Infants with GA > 32 Weeks, n=101	p
Duration of invasive ventilation, days	Me [Lq; Uq]]	10.5 [6.00; 16.5]	8.00 [6.00; 12.00]	0.003*
Intraventricular hemorrhage	n (%)	42 (28.8)	15 (14.9)	0.124
Neonatal seizures	n (%)	22 (15.1)	7 (6.9)	0.049*
Feeding with maternal milk (or mixed)	n (%)	72 (49.3)	31 (30.7)	0.004*

Notes: *Statistically significant results. Me [Lq; Uq] - Median [Lower quartile; Upper quartile].

extremely and very premature infants was (29.66±2.27) weeks, birth weight – (1400.00 [990.0; 1650.00] grams; in moderately and late premature infants – GA was (34.00 ± 1.02) weeks and birth weight 1950.00 [1700.00; 2200.00] grams. There were 29 twins in total: 16 (11.0%) among infants with GA ≤ 32 weeks and 13 (12.9%) among those with GA > 32 weeks (p=0.875).

Fetal distress more often was present among moderately and late preterm infants compared to extremely and very preterm neonates (22.8% vs 13.0%, p=0.044). Anthropometric indicators (birth weight and length), Apgar scores, and clinical characteristics of the infants are presented in Table 1. The incidence of respiratory distress syndrome, neonatal seizures, need for mechanical ventilation, length of NICU stay, and duration of mechanical ventilation were significantly higher in infants with GA ≤ 32 weeks (Table 1).

The maternal total PSS: NICU score was 3.36±0.74. It was significantly higher in mothers of preterm neonates delivered before 32 weeks of gestation compared to those who delivered infants after 32 weeks (3.46±0.70 vs 3.20±0.77, p=0.0048). Parental Role Alteration was the most stressful for mothers of both GA groups (4.20±0.79 and 3.98±0.89) followed by Infant Appearance and Behavior (3.58±0.89 and 3.20±0.92) and Sights and Sounds subscales (2.17±0.89 and 2.15±0.93), $p_{(S1–S2)}$ <0.001, $p_{(S1–S3)}$ <0.001, $p_{(S2–S3)}$ <0.001 both GA groups. Significant differences in stress level were associated with Parental Role Alteration and Infant Appearance and Behavior in the mothers of the two age groups (p<0.001 and p=0.045, respectively) (Figure 1). Stress related to Sights and Sounds in the NICU did not differ by

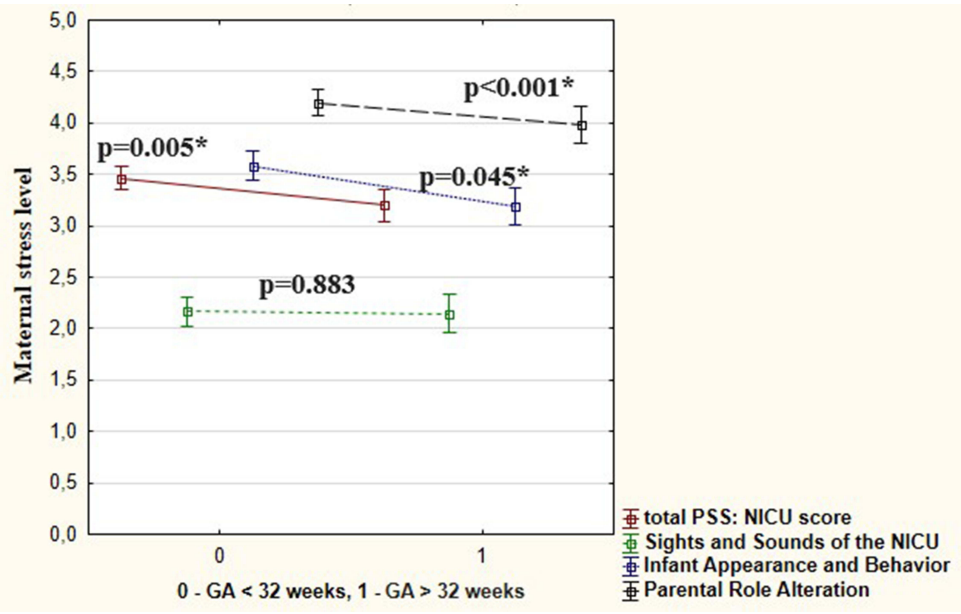

Figure 1 Total PSS: NICU and its subscales stress level in mothers of preterm infants with GA ≤ 32 weeks and GA > 32 weeks (* – Statistically significant results).

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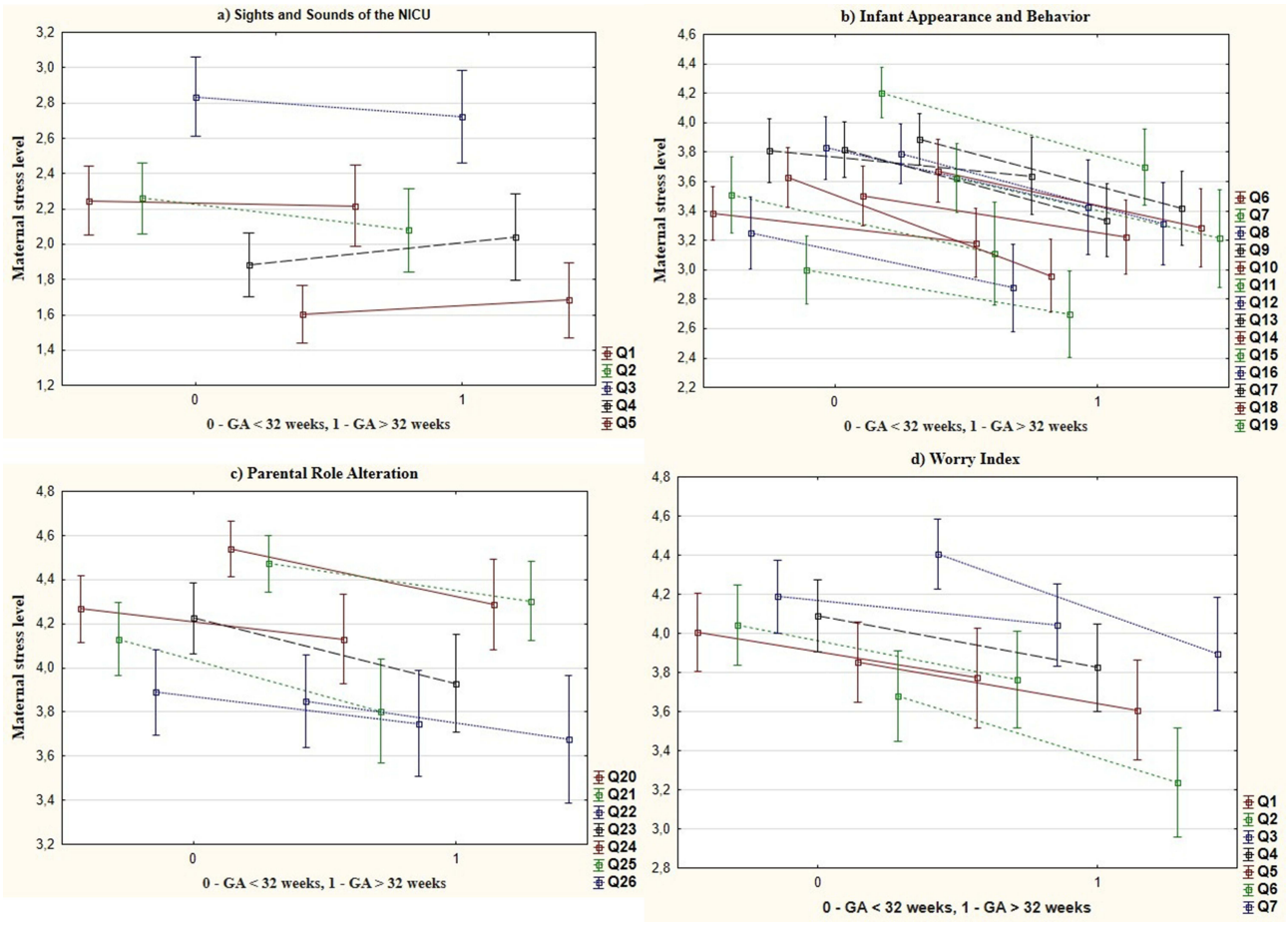

Figure 2 (**a**) Maternal stress level (Sights and Sounds of NICU) in mothers of preterm infants with GA ≤ 32 weeks and GA > 32 weeks. (**b**) Maternal stress level (Infant Appearance and Behavior) in mothers of preterm infants with GA ≤32 weeks and GA > 32 weeks. (**c**) Maternal stress level (Parental Role Alteration) in mothers of preterm infants with GA ≤ 32 weeks and GA > 32 weeks. (**d**) Worry Index in mothers of preterm infants with GA ≤ 32 weeks and GA > 32 weeks.

gestational age (p=0.883) (Figure 1). Figure 2 presents the maternal stress levels for each item of the three PSS subscales —NICU and Worry Index—in mothers from both study groups.

The Worry Index was 27.41±7.15. It was significantly higher in mothers of preterm infants with GA ≤ 32 weeks compared to those whose infants had GA > 32 weeks (28.26±7.11 vs 26.14±7.07, p=0.0229).

Total PSS: NICU scores, S2 and S3 scores, and the Worry Index were negatively correlated with GA (r=−0.175, p=0.007; r=−0.180, p=0.005 and r=−0.141, p=0.027; r=−0.15, p=0.019, respectively) (Figure 3).

Cronbach's alpha coefficients for the Ukrainian version of the PSS: NICU indicated good consistency for each subscale (for S1: 0.81; S2: 0.94; S3: 0.90), and the entire scale (0.95), and for the Ukrainian version of the Worry Index – 0.92.

Items that were highly stressful included (M ≥ 4.0 for one or both groups) seeing a child in pain, being separated from the child, being unable to feed and hold the child, and feeling helpless and unable to protect the child from pain, feeling helpless about how to help the child. For any item with a score higher than 4.0 in one group, the corresponding scores from the other group were included for comparison (Table 2).

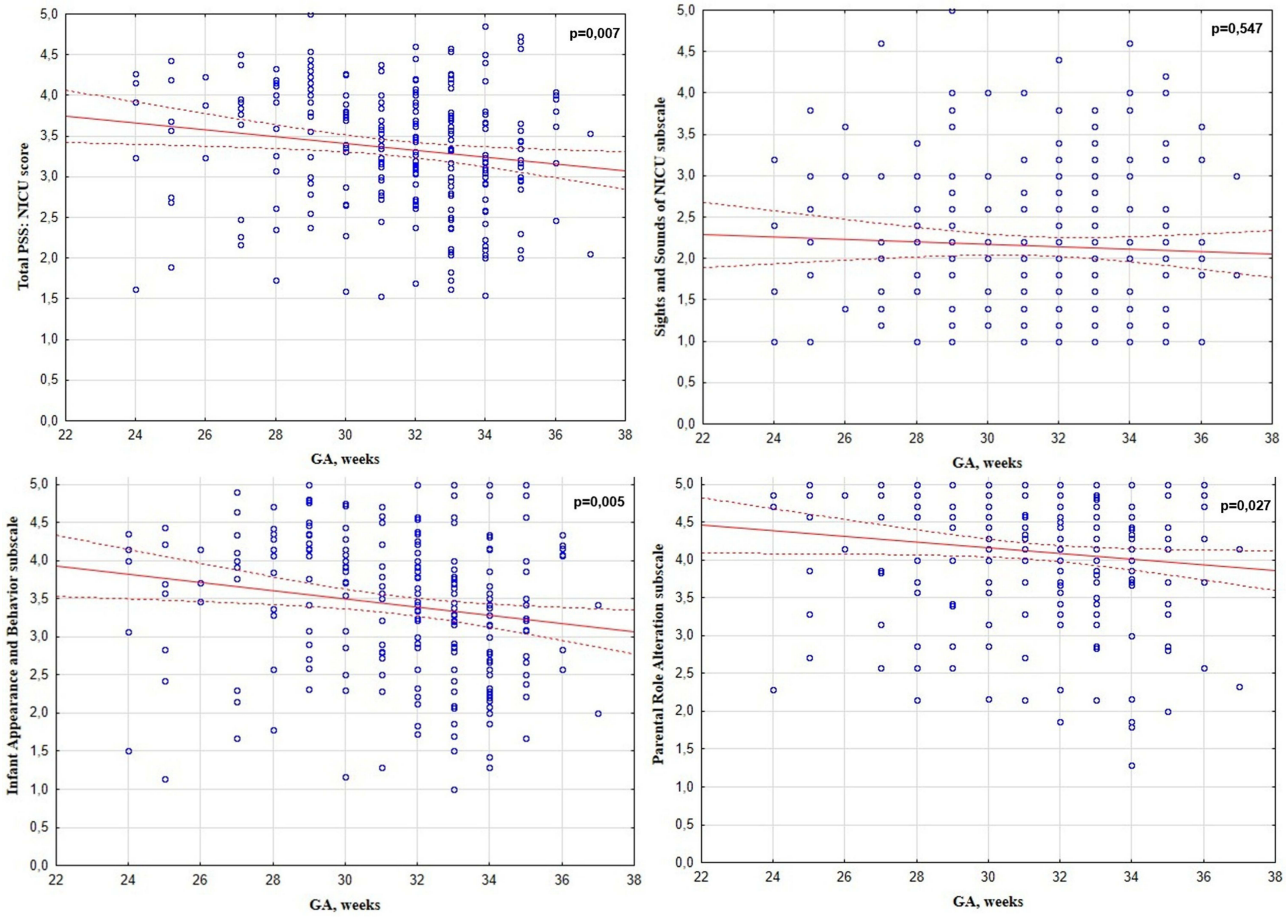

Figure 3 Correlations between total PSS: NICU scores, Sights and Sounds of NICU subscale, Infant Appearance and Behavior subscale, and Parental Role Alteration subscales scores with the GA.

Peculiarities of Parental NICU-Related Stress in Mothers of Extremely and Very Preterm Neonates

The most stressful items in the Parental Role Alteration subscale (S3) were "Feeling helpless and unable to protect baby from pain and painful procedures" (4.54±0.77), "Feeling helpless about how to help baby" (4.47±0.79) and "Being separated from the baby" (4.26±0.93).

Table 2 The Most Stressful Items of Maternal Stress in the Study Groups

	Mother of Preterm Infants with GA ≤ 32 Weeks, n=146	**Mother of Preterm Infants with GA > 32 Weeks, n=101**	**p**
Seeing child in pain	4.20±0.99	3.70±1.18	0.000*
Being separated from the child	4.27±0.93	4.13±1.02	0.277
Being unable to feed the child	4.13±1.01	3.80±1.16	0.020*
Being unable to hold the child	4.23±0.98	3.93±1.11	0.028*
Feeling helpless and unable to protect the child from pain and painful procedures	4.54±0.77	4.29±1.03	0.029*
Feeling helpless about how to help the child	4.47±0.79	4.30±0.91	0.121

Notes: *Statistically significant results.

The most stressful factors in the Infant Appearance and Behavior subscale (S2) were "When the baby seemed to be in pain" (4.20±0.99), "The limp and weak appearance of baby" (3.89±1.03), and "Having a machine (respirator) breathe for baby" (3.83±1.18).

The most stressful items in the Sights and Sounds of NICU subscale (S1) were "The sudden noises of monitor alarms" (2.84±1.38), "The constant noises of monitors and equipment" (2.26±1.24), and "The presence of monitors and equipment in the intensive care unit" (2.25±1.20).

Total PSS: NICU and Sights and Sounds of NICU subscale scores were higher in mothers who had episodes of depression before delivery (p=0.049 and p=0.023, respectively). Mothers who had given birth via cesarean section had significantly higher Parental Role Alteration subscale scores than those who had vaginal delivery (p=0.024). Mothers of twins experienced greater stress related to Parental Role Alteration than mothers of singletons did (p=0.048). Mothers who breastfed their infants had lower stress scores, particularly on the Parental Role Alteration subscale (p=0.011) (Table 3).

Maternal stress was associated with the infant's health status and morbidity. Neonatal seizures caused an increase in the total PSS: NICU (p=0.022), Infant Appearance and Behavior (p=0.030), and Parental Role Alteration subscales (p=0.008), and neonatal infection caused a higher total PSS: NICU and Infant Appearance and Behavior subscale scores (p=0.045 and p=0.039, respectively) (Table 3).

The Worry Index was associated with maternal educational level and mode of delivery (p=0.038 and p=0.000, respectively; Table 3).

Table 3 PSS: NICU Scores in Mothers of Extremely and Very Preterm Infants in Relation to the Maternal and Neonatal Factors

		Total PSS: NICU Score	Sights and Sounds (S1) Score	Infant Appearance and Behavior (S2) Score	Parenteral Role Alteration (S3) Score	Worry Index
	n (%)	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
MATERNAL CHARACTERISTICS						
Educational level: - Higher education - Secondary and incomplete secondary education p-value	 84 (57.5) 62 (42.5)	 3.43±0.79 3.51±0.57 0.476	 2.13±0.88 2.21±0.91 0.609	 3.52±0.98 3.67±0.75 0.316	 4.17±0.86 4.22±0.69 0.740	 27.19±7.85 29.66±5.77 0.038*
Employment status: - employed - unemployed p-value	 83 (56.8) 63 (43.2)	 3.50±0.70 3.42±0.71 0.488	 2.20±0.96 2.12±0.79 0.594	 3.63±0.87 3.52±0.93 0.509	 4.21±0.79 4.18±0.80 0.832	 28.26±7.09 28.27±7.19 0.996
Presence of depression episodes before childbirth: - Yes - No p-value	 30 (20.5) 116 (79.5)	 3.69±0.64 3.41±0.71 0.049*	 2.49±0.94 2.08±0.86 0.023*	 3.81±0.95 3.53±0.91 0.171	 4.36±0.70 4.17±0.80 0.224	 30.51±4.94 27.79±7.44 0.061
Parity - 1 - ≥ 2 p-value	 58 (39.7) 88 (60.3)	 3.49±0.75 3.45±0.68 0.748	 2.21±0.94 2.14±0.86 0.622	 3.62±0.93 3.56±0.87 0.695	 4.17±0.84 4.21±0.77 0.823	 28.58±7.02 28.02±7.24 0.650

(*Continued*)

Table 3 (Continued).

		Total PSS: NICU Score	Sights and Sounds (S1) Score	Infant Appearance and Behavior (S2) Score	Parenteral Role Alteration (S3) Score	Worry Index
	n (%)	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Pregnancy						
- Singleton	130 (89.0)	3.43±0.70	2.15±0.87	3.55±0.90	4.15±0.81	28.03±7.32
- Twins	16 (11.0)	3.74±0.67	2.31±1.04	3.86±0.82	4.56±0.55	30.13±4.95
p-value		0.094	0.485	0.190	0.048*	0.267
Delivery mode						
- Vaginal delivery	56 (38.4)	3.38±0.67	2.11±0.87	3.55±0.79	4.01±0.85	25.79±8.31
- Caesarean section	90 (61.6)	3.52±0.73	2.20±0.90	3.60±0.96	4.31±0.74	29.87±5.72
p-value		0.234	0.582	0.723	0.024*	0.000*
INFANTS' CHARACTERISTICS						
Respiratory distress syndrome						
- Yes	120 (82.2)	3.47±0.74	2.14±0.89	3.59±0.95	4.22±0.83	28.09±7.39
- No	26 (17.8)	3.45±0.50	2.28±0.89	3.55±0.62	4.09±0.62	29.04±5.76
p-value		0.929	0.453	0.859	0.443	0.541
Early-onset sepsis						
- Yes	67 (45.9)	3.62±0.66	2.22±0.89	3.78±0.83	4.34±0.72	28.94±6.70
- No	79 (54.1)	3.39±0.69	2.15±0.90	3.49±0.86	4.12±0.83	28.05±7.25
p-value		0.045*	0.644	0.039*	0.098	0.460
Intraventricular hemorrhage						
- Yes	42 (28.8)	3.62±0.67	2.23±0.83	3.77±0.82	4.34±0.77	28.45±7.31
- No	104 (71.2)	3.45±0.68	2.17±0.94	3.57±0.87	4.19±0.77	28.59±6.82
p-value		0.191	0.740	0.202	0.305	0.916
Neonatal seizures (convulsive syndrome)						
- Yes	22 (15.1)	3.80±0.43	2.22±0.60	3.99±0.59	4.62±0.40	28.37±6.11
- No	124 (84.9)	3.45±0.71	2.18±0.94	3.57±0.88	4.16±0.80	28.57±7.09
p-value		0.022*	0.873	0.030*	0.008*	0.904
Invasive ventilation						
- Yes	69 (47.3)	3.57±0.75	2.28±0.94	3.71±0.89	4.24±0.80	29.55±6.00
- No	77 (52.7)	3.42±0.63	2.08±0.86	3.52±0.86	4.21±0.76	27.69±7.65
p-value		0.192	0.184	0.200	0.832	0.113
Type of feeding:						
- Breastfeeding and mixed feeding	72 (49,3)	3.44±0.67	2.26±0.92	3.58±0.83	4.08±0.80	28.46±6.70
- Formula feeding	74 (50,7)	3.57±0.69	2.11±0.87	3.68±0.89	4.40±0.71	28.64±7.24
p-value		0.260	0.334	0.146	0.011*	0.885

Notes: *Statistically significant results.

Peculiarities of Parental NICU-Related Stress in Mothers of Moderate and Late Preterm Neonates

The most stressful factors in the Parental Role Alteration subscale (S3) were "Feeling helpless about how to help baby" (4.30±0.91), "Feeling helpless and unable to protect baby from pain and painful procedures" (4.29±1.03) and "Being separated from the baby" (4.13±1.02).

The most stressful factors in the Infant Appearance and Behavior subscale (S2) were "When the baby seemed to be in pain" (3.70±1.18), "Baby's unusual or abnormal breathing patterns" (3.64±1.22), and "Having a machine (respirator) breathe for baby" (3.42±1.37).

The most stressful items in the Sights and Sounds of NICU subscale (S1) were "The sudden noises of monitor alarms" (2.72±1.34), "The constant noises of monitors and equipment" (2.22±1.16), and "The presence of monitors and equipment in the intensive care unit" (2.08±1.19).

Maternal stress was associated with the maternal employment status (p=0.043 for Parental Role Alteration stress score). In contrast to mothers of extremely and very preterm infants, mothers of moderate and late preterm neonates had higher stress levels in the case of vaginal delivery (p=0.035 for total PSS: NICU score and p=0.048 for Parental Role Alteration stress score; Table 4). Mothers with older children had significantly higher scores on the Parental Role Alteration subscale compared to primiparous women (p=0.042). There were no significant associations between the total PSS: NICU and its subscales scores, infant's health status and morbidity in mothers of moderate and late preterm neonates (Table 4).

Table 4 PSS: NICU Scores in Mothers of Moderate and Late Preterm Infants in Relation to the Maternal and Neonatal Factors

	n (%)	Total PSS: NICU Score	Sights and Sounds (S1) Score	Infant Appearance and Behavior (S2) Score	Parenteral Role Alteration (S3) Score	Worry Index
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
MATERNAL CHARACTERISTICS						
Educational level:						
- higher education	46 (45,5)	3.22±0.86	2.39±1.00	3.17±0.99	3.89±0.98	24.59±6.52
- secondary and incomplete secondary education	55 (54,5)	3.18±0.69	1.95±0.83	3.21±0.87	4.05±0.81	27.57±7.23
p-value		0.821	0.016*	0.847	0.372	0.036*
Employment status:						
- employed	52 (56.8)	3.17±0.79	2.18±0.95	3.20±0.91	3.81±0.97	24.70±7.18
- unemployed	49 (43.2)	3.23±0.74	2.11±0.91	3.18±0.94	4.16±0.77	27.70±6.60
p-value		0.655	0.660	0.947	0.043*	0.035*
Presence of depression episodes before childbirth:						
- Yes	23 (20.5)	3.30±0.85	2.38±1.01	3.32±0.90	3.92±1.08	28.86±6.48
- No	78 (79.5)	3.17±0.74	2.08±0.90	3.15±0.93	4.00±0.83	25.36±7.03
p-value		0.453	0.188	0.457	0.729	0.039*
Parity						
- 1	44 (43.6)	3.14±0.86	2.19±0.97	3.17±1.01	3.80±1.02	25.74±7.58
- ≥ 2	57 (56.4)	3.26±0.68	2.12±0.92	3.22±0.850.81	4.16±0.70	26.63±6.60
p-value		0.424	0.701	3	0.042*	0.540
Pregnancy						
- Singleton	88 (87.1)	3.17±0.79	2.14±0.95	3.15±0.96	3.94±0.93	25.93±7.15
- Twins	13 (12.9)	3.42±0.51	2.20±0.81	3.48±0.59	4.27±0.47	27.62±6.28
p-value		0.256	0.832	0.231	0.209	0.424
Delivery mode						
- Vaginal delivery	36 (35.6)	3.43±0.76	2.27±0.93	3.43±0.91	4.21±0.88	26.70±7.35
- Caesarean section	65 (64.4)	3.06±0.78	2.04±0.95	3.05±0.94	3.81±0.90	26.28±6.84
p-value		0.035*	0.276	0.069	0.048*	0.797*

(*Continued*)

Table 4 (Continued).

	n (%)	Total PSS: NICU Score	Sights and Sounds (S1) Score	Infant Appearance and Behavior (S2) Score	Parenteral Role Alteration (S3) Score	Worry Index
		Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
INFANTS' CHARACTERISTICS						
Respiratory distress syndrome						
- Yes	38 (37.6)	3.08±0.74	1.92±0.82	3.10±0.87	3.90±0.92	24.86±6.72
- No	63 (62.4)	3.26±0.78	2.28±0.97	3.24±0.96	4.02±0.88	26.80±7.16
p-value		0.268	0.059	0.459	0.507	0.192
Early-onset sepsis						
- Yes	35 (34.7)	3.21±0.78	2.05±0.90	3.28±0.92	3.95±0.89	26.47±6.08
- No	66 (65.3)	3.17±0.79	2.17±0.96	3.13±0.95	3.95±0.91	26.47±7.47
p-value		0.831	0.570	0.486	0.987	0.998
Intraventricular hemorrhage						
- Yes	15 (14.9)	3.09±0.76	2.17±1.01	2.97±1.01	3.99±0.74	25.69±10.6
- No	86 (85.1)	3.21±0.79	2.12±0.94	3.23±0.93	3.96±0.92	26.72±6.14
p-value		0.616	0.863	0.363	0.909	0.627
Neonatal seizures (convulsive syndrome)						
- Yes	7 (6.9)	3.53±0.70	1.97±0.94	3.58±0.88	4.55±0.40	33.40±2.19
- No	94 (93.1)	3.16±0.79	2.14±0.94	3.16±0.94	3.91±0.91	26.04±6.91
p-value		0.264	0.669	0.287	0.094	0.021*
Invasive ventilation						
- Yes	19 (47.3)	3.26±0.72	2.36±0.98	3.29±0.83	3.85±0.74	26.72±6.55
- No	82 (52.7)	3.17±0.80	2.07±0.92	3.16±0.97	3.98±0.94	26.40±7.09
p-value		0.669	0.247	0.593	0.580	0.864
Type of feeding:						
- Breastfeeding and mixed feeding	31 (30.7)	3.24±0.74	2.34±0.94	3.25±0.83	3.87±0.92	25.36±5.71
- Formula feeding	70 (69.3)	3.17±0.81	2.03±0.93	3.16±0.99	3.99±0.90	26.93±7.39
p-value		0.690	0.155	0.683	0.590	0.344

Notes: *Statistically significant results.
Abbreviations: GA, gestational age; PSS, Parental Stressor Scale: Neonatal intensive care unit; WI, Worry Index; S, subscale; NICU, neonatal intensive care unit; M, mean; SD, standard deviation; Me, median; Lq, lower quartile; Uq, upper quartile.

The Worry Index was associated with maternal education level (p=0.036), employment status (p=0.035), presence of depressive episodes before childbirth (p=0.039), and presence of neonatal seizures in infants (p=0.021) (Table 4).

Discussion

The primary goal of this study was to assess the levels of stress and worry experienced by mothers of preterm infants across different gestational ages. The secondary aim was to identify factors influencing maternal stress according to gestational age. Understanding these factors contributing to parental stress in the NICU can help healthcare providers pinpoint areas for targeted interventions to improve outcomes for both parents and infants.[20]

Our study emphasizes the significant emotional burden that mothers may experience during the neonatal period. The results showed that NICU-related maternal stress depended on gestational age: the lower gestational age, the higher the stress and worry indices. Mothers of preterm infants with GA ≤ 32 weeks had significantly higher total PSS: NICU scores, stress scores associated with Parental Role Alteration and Infant Appearance and Behavior, and Worry index that those delivered after 32 weeks. This finding was also confirmed by the negative correlation of total PSS: NICU scores, S2 and S3 scores, and the Worry Index with gestational age.

These findings can be attributed to the fact that premature infants are at a high risk of severe morbidity, and developmental disabilities and are also more susceptible to life-threatening conditions due to the immaturity of all organs and systems (gastrointestinal, respiratory, neurological, and cardiovascular).[12,21] Long-term outcomes vary widely and are very difficult to predict, adding to the uncertainty experienced by parents early in their child's life.[22] The more premature an infant is, the greater the risk of morbidity and mortality.[23] Accordingly, maternal worry and anxiety, leading to stress, may be higher in mothers of extremely and very preterm infants than in mothers of moderately and late preterm neonates. The larger gestational age, the more confident and calm parents are about the lesser complications their child may encounter.[5] In addition, infants born at a younger gestational age require a longer duration of NICU stay and more complex specialized medical care.[5] As a result, there is a longer separation, sometimes the inability of full-fledged kangaroo care in the NICU, a greater inability of parents to participate in the care of the child due to the life support equipment (respirators, monitors, catheters, tubes) and numerous treatment procedures.[12]

Our results are in line with other authors, who revealed association of NICU-related stress with gestational age, namely significant negative correlation between gestational age and maternal uncertainty.[24,25] Umasankar et al found that lower gestational age was associated with higher stress levels in mothers.[26] Turner et al stated that very premature birth and twin birth were significantly associated with a higher PSS: NICU scores.[27] Recent studies and systematic review reported that low gestational age and very low birth weight were the most common causes of maternal stress stress.[11,28,29] However, Woodward L. et al showed that gestational age and birth weight did not correlate with the maternal stress.[30]

Regarding the different areas of stress, Parental Role Alteration was the most stressful subscale for mothers in both gestational age groups, followed by Infant Appearance and Behavior, and Sights and Sounds subscales. This indicates that mothers' relationships with their infant and their perceptions of the infant's appearance are most closely associated with overall stress levels. This finding aligns with numerous studies that have identified the perceived loss of the parental role as a prominent NICU-related stressor.[24,31,32] In addition, the results of a meta-analysis conducted by Caporali et al showed that Parental Role Alteration was the most relevant source of stress for parents in the NICU, and the stress related to the physical appearance of the infant was the second greatest source of burden. When infants are admitted to the NICU, the process of physiological parental attachment can be disrupted because of physical separation, inability to take care of the child, and other unique conditions in the intensive care unit.[3]

The most difficult experiences for mothers in both gestational age groups were separation from their child and feelings of helplessness about how to help him or her. If left unaddressed, maternal stress can impair a mother's ability to care for her infant and disrupt the bonding process, potentially leading to adverse effects on the child's future developmental outcomes.[33]

Some studies emphasized that infants' appearance has the most frequent and significant impact on maternal stress, followed by Parental Role Alterations.[12,34] Only a few studies reported that the highest level of stress was observed in the Sight and Sound domains, followed by the relationship with the baby and parental role.[35] Stress associated with Sights and Sounds was the lowest in mothers of preterm infants who participated in our study. This can be explained by the fact that, in today's technological age, parents are relatively-adapting to the resuscitation environment and perceive it as part of the comprehensive care of their infants.[14] Sights and Sounds scores also did not depend on the gestational age.

Our study identified important factors associated with maternal stress in the NICU. By analyzing this in detail, we revealed some differences in NICU-related stress in mothers of premature infants of different gestational ages. Stress levels were associated with the health status of the child in mothers of extremely and very preterm neonates. In particular, the total PSS: NICU, Infant Appearance and Behavior and Parental Role Alterations scores were higher in mothers whose children had neonatal seizures. Neonatal infection was associated with higher overall maternal stress, as well as increased stress related to Infant Appearance and Behavior. Meanwhile, the total PSS: NICU and its subscales scores were not associated with infants' morbidity in mothers of moderate and late preterm neonates, with the exception of the worry index, which was higher in case of neonatal seizures. We attributed this difference to the fact that with decreasing gestational age, the risk and severity of neonatal infection and neurological disorders increases.[36] And these diseases were significantly prevalent among extremely and very premature infants in our study population. The existing literature indicates that parents of children with complex medical or chronic conditions, including neonatal seizures, are at a high risk for psychosocial problems.[37,38] The current meta-analysis conducted by Caporali et al showed, that parental stress

experience in the NICU is at least partially independent of gestational age at birth, birth weight, and newborns' comorbidities, and the very fact of a child's admission to the NICU plays a key role in the parents' stress perception. However, this meta-analysis included only one study focused on extremely low birth weight infants, and only one-third of the included studies involved low-birth-weight infants.[3]

Any episode of depression before delivery was associated with higher stress scores in mothers of extremely and very preterm neonates, and with a higher Worry Index in mothers of moderate and late preterm newborns. Current literature indicates that mental disorders in mothers can be influenced by previous mental health histories, such as anxiety, depression, and post-traumatic stress disorder.[39]

The Worry Index was associated with maternal education level, being significantly higher in mothers with secondary and incomplete secondary education in both groups. The total PSS: NICU score was also higher in mothers of moderate and late preterm infants with secondary or incomplete education. In addition, higher stress scores and worry index were associated with unemployed status in this group of mothers. This could be attributed to the social adversity (low education, single parenthood, and prior stressful life events) that places families at increased risk of stress in the NICU.[40] On the other hand, education can increase mothers' ability to access relevant information about the caregiving and needs of premature infants, enabling them to engage in effective problem-solving, including self-adaptation, which together alleviates emotional distress, improves mental health, and reduces stress.[5] Similar results have been documented in other studies that indicated that mothers with higher educational attainment reported lower levels of stress compared to parents with lower levels of education.[30,41] Recent literature suggests that social support, family income, and maternal education level were significantly negatively correlated with anxiety and depression among mothers of neonates in the NICU.[42]

We also found that stress and anxiety levels were associated with the delivery mode in both groups, but mothers of extremely and very preterm infants had higher stress in the case of cesarean section, and mothers of moderate and late preterm neonates had higher stress in the case of vaginal delivery. Tilahun's study showed that mothers of preterm infants born between 32 and 34 weeks of gestation experienced nearly three times higher levels of stress compared to mothers who delivered at term via vaginal birth.[5] Hendy et al also revealed that mothers delivered through cesarean section were 1.4 times more likely to be stressed in comparison to vaginal delivery, but their study included some proportion of term neonates in addition to preterm neonates, and there was no detailed information about the gestational age of preterm infants.[12] Akkoyun et al reported that cesarean-section was one of the most common causes of parental stress.[43] This can be explained by several factors. First, an early preterm birth is always unexpected and inherently stressful. Second, the complexity of a cesarean section with its associated surgical procedure and possible complications can further contribute to maternal stress.[5] In addition, the mother always needs a recovery period after a cesarean section, which further leads to parental role alteration, separation, and inability to fully care for the child.

The presence of older children in the family did not affect stress scores in mothers of extremely and very preterm infants; however, mothers of moderate and late preterm neonates who had older children experienced higher stress associated with parental role alterations than primiparous women. This could be contributed to the fact that while their neonates are in the NICU, mothers often have to dedicate significant time either at the hospital or commuting between the hospital and their home, thus being separated from older children, unable to care for them.[44] Similarly, Çekin et al found that mothers who had children other than the infant in the NICU had higher levels of stress.[45] However, this result contradicts the findings reported by Moon et al. The authors assessed the NICU-related stress level in mothers of preterm infants with a mean gestational age of 27.8 weeks, and revealed that parental stress was associated with having a single child.[34] Kawafha M. et al observed the same trend.[46] They explained their findings by the novelty of parenting, coupled with the uncertainty and unfamiliarity surrounding preterm birth.[34,46]

Mothers of extremely and very preterm twins experienced greater stress regarding Parental Role Alteration than mothers of singletons did. This finding is in line with Turner et al's study, which stated that very premature births and twin births were significantly associated with higher PSS: NICU scores.[27]

In contrast, breastfeeding was identified as a protective factor that reduced maternal stress. Mothers of extremely and very preterm infants who breastfed reported lower stress scores on the Parental Role Alteration subscale. It is known that the infant's stay in the NICU provokes anxiety and fear in the mother, which affects lactation and breastfeeding

success.[47,48] Lower stress scores associated with Parental Role Alteration in mothers who breastfed their infants confirm the uniqueness of breastfeeding both for maintaining the mother-child bond and reducing maternal stress.[49,50] Evidence suggests that breastfeeding practices effects the mother by reducing neuroendocrine responses to stress and improving maternal mood.[50] However, there is limited literature on the impact of stress on lactation and breastfeeding in mothers whose infants are in the NICU. Foligno et al found that high PSS: NICU reduce breastfeeding frequency by three times,[49] which is consistent with our results.

Practical Implementations

Our study highlights the importance of addressing the psychosocial needs of mothers of preterm infants in the NICU. It is necessary to assess the level of maternal NICU-related stress and factors that potentially lead to or exacerbate it. First, mothers should be provided with rapid access to mental healthcare staff. The best solution in this case involves psychologists in the perinatal care teams. On the other hand, NICU staff should be acquainted with and ready to deal with maternal psychological disorders to prevent or reduce their severity in the early stages. As for our results regarding Parental Role Alteration subscale scores, it seems important to involve mothers in infants' routine care, encourage skin-to-skin contact and parents' active participation in decision-making solutions, and place the parental role at the center of care during NICU treatment. In general, this research emphasizes the need for family-centered care implementation in neonatal practice. Recent multi-country studies have reported that parent-centered and family-integrated care decreased maternal stress in the NICU and specifically ameliorated stress associated with parental role alteration.[1,31,51] Considering that maternal NICU-related stress levels were strongly correlated with gestational age, these mothers need special psychological support with encouragement to establish physical and emotional closeness with their infants.[52]

Strengths and Limitations of the Study

The main strength of this study is that it is the first known study of NICU-related maternal stress in preterm infants in Ukraine. In addition, the study was conducted in five centers in different regions; therefore, the results are entirely generalizable and detect the main problems that mothers face in the NICU.

The main limitation of our study is the relatively small number of interviewed mothers, which should be taken into account when interpreting the findings. Additionally, the exclusion of fathers represents another limitation, reducing the generalizability of the results regarding a comprehensive understanding of maternal stress in the NICU.

Conclusion

The level of NICU-related stress and the Worry Index in mothers of preterm neonates were negatively correlated with gestational age and were significantly higher in mothers of infants born at ≤ 32 weeks of gestation. Neonatal seizures, neonatal infection, cesarean section, twins, maternal secondary or incomplete secondary education, and any episodes of depression before delivery were factors associated with higher stress levels and worry indices in mothers of extremely and very preterm infants, while unemployment, vaginal delivery, and older children in the family increased stress and worry levels in mothers of moderate and late preterm neonates. However, breastfeeding has been identified as a protective factor that helps reduce maternal stress. These findings can help clinical staff identify parents who are at risk of experiencing high levels of stress.

Parental role alteration was the greatest stressor followed by Infant Appearance and Behavior and NICU-surrounding stressor factors in all mothers of preterm neonates, regardless of gestational age. These results show the need for interventions and counseling focused on supporting mothers' role, encouraging their early involvement in infant care, and promoting family-centered care approaches.

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