

## The Effect of Hospitalization in the Neonatal Intensive Care Unit on Maternal Stress and Attachment: Neonatal Intensive Care Unit Environment Effect

### ABSTRACT

**Objective:** This study investigated the effects of hospitalization in the neonatal intensive care unit (NICU) due to congenital pneumonia (CP) on maternal stress and attachment, focusing on how the duration of invasive and noninvasive mechanical ventilation, length of NICU stay, and postpartum breastfeeding initiation time influence mother–infant attachment.

**Methods:** Conducted among 30 mothers of 3-month-old infants admitted to the NICU with CP and a control group (n = 30), it analyzed the impact of medical intervention durations and breastfeeding initiation on maternal stress and attachment using statistical methods.

**Results:** The maternal stress in the NICU group was significantly higher than in the control group ( $P = .014$ ). However, there was no significant difference between the groups in attachment scores ( $P = .141$ ). The study revealed that longer invasive mechanical ventilation ( $P < .001$ ) and NICU stay ( $P < .001$ ) significantly increased maternal stress. Maternal stress ( $P < .001$ ) and breastfeeding initiation time ( $P < .001$ ) exhibit a negative correlation with attachment scores ( $P < .001$ ).

**Conclusion:** It is crucial to implement interventions aimed at reducing maternal stress and fostering maternal–infant attachment for mothers of newborns admitted to the NICU. The sustained application of these interventions post discharge holds significance for the mental health of mothers and mother–infant attachment.

**Keywords:** Attachment, neonatal intensive care unit, stress, congenital pneumonia, maternal behavior

### Introduction

Congenital pneumonia (CP), a severe disease emerging within the first day of life, is more common in societies with low socioeconomic status and often resulting in substantial medical complications and mortality.<sup>1</sup> Many neonates diagnosed with CP are admitted to the neonatal intensive care unit (NICU), a process that markedly increases parental psychosocial stress,<sup>2</sup> subjecting them to acute distress and possibly affecting their parenting capabilities.<sup>3</sup>

Early interactions that foster attachment between a child and their caregiver are pivotal in modulating individual stress responses.<sup>4,5</sup> Attachment theory posits that individual attachment is a reflection of dyadic interactions, significantly influenced by the behaviors of key adults in a child's life (parents or primary caregivers). These recurrent interactions become internalized, influencing the child's biological and behavioral responses to stress.<sup>6</sup> Early positive attachment between a parent and their infant fosters the development of parenting skills,<sup>7</sup> enhances parents' sensitivity to their children's needs, and promotes the children's socio-emotional development.<sup>7,8</sup> Furthermore, positive attachment experiences enhance children's resilience and compliance in managing diseases later in life.<sup>9-11</sup>



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The attachment between mother and infant, initiated during pregnancy and perpetuated post birth, might be disrupted by medical conditions that limit or prevent physical contact. This bond is also shaped by prenatal, perinatal, and postnatal factors. Prenatal depression and anxiety are associated with postnatal mother–infant attachment and might have detrimental effects.<sup>12,13</sup> Mothers with a prenatal depression history, especially those with neonates admitted to the NICU, might experience heightened distress. Prolonged hospitalization in the NICU has been known to affect mother–infant attachment adversely.<sup>14–16</sup> Factors such as low birth weight, traumatic or difficult birth, preterm delivery, and perinatal complications generate parental distress and increase the prevalence of psychiatric symptoms.<sup>17</sup> Parents face challenges such as interfacing with complex medical equipment, constricted interaction times with their babies, and nascent medical complications.<sup>18,19</sup> NICU-induced challenges encounter a situation that can significantly impair mother–infant attachment and parenting skills.<sup>20</sup>

Both parents experience stress during NICU hospitalization,<sup>2,21,22</sup> negatively affecting parenting competencies.<sup>23</sup> Although the NICU experience affects both parents, mothers might face distinct challenges.<sup>16</sup> Increased early maternal stress may hinder mother–infant attachment and inhibit neonatal development.<sup>24,25</sup> Studies show that maternal anxiety leads to poor motor development in infants in the following months and adversely affects mother–infant interactions.<sup>26,27</sup>

Maternal stress can adversely influence mothers' perceptions and reactions to their infants' behaviors and movements. Admission to the NICU is associated with an increased risk of maternal anxiety and postpartum depression.<sup>28,29</sup> Recently, the discussion has pivoted to exploring intervention strategies aimed at reducing maternal stress, promoting the infant's psychomotor development, fostering mother–infant attachment, and enhancing maternal mental health.<sup>30–33</sup>

The interplay between NICU admission, maternal stress, and mother–infant attachment has been well documented.<sup>16,34–36</sup> However, the effects of NICU stay duration and specific medical interventions on maternal stress and mother–infant attachment still need to be explored. This study compares stress levels and attachment scores between mothers of infants hospitalized in the NICU for CP (NICU mothers) and those of healthy controls at 3 months postpartum. Furthermore, it examines the correlations between invasive mechanic ventilation time (IMVT), non-invasive mechanic ventilation time (NIMVT), postpartum breastfeeding initiation time (BFT), NICU stay duration (HD), maternal stress, and mother–infant attachment in neonates hospitalized in the NICU.

## MAIN POINTS

- *Invasive procedures in the neonatal intensive care unit (NICU) environment can increase maternal stress and adversely affect mother–infant attachment.*
- *The duration of NICU stay impacts not only maternal stress but also the mother–infant attachment.*
- *It is essential to not only implement strategies to alleviate maternal stress but also to minimize the duration of invasive medical procedures. Moreover, promoting healing and facilitating mother engagement during these interventions is crucial.*

## Material and Methods

### Study Design

This study was conducted at the Katip Çelebi University and approved by the Noninvasive Clinical Researches Ethics Committee (Approval number: 898; Date: September 17, 2020). Following ethics committee approval, researchers introduced the study, reviewed eligibility criteria, and recruited mothers of CP infants and healthy infants for participation in the 3-month follow-up examination. Participants who consented provided written approval. The study included 60 mothers without psychiatric disorders or reported psychiatric symptoms of CP infants and controls between September 2020 and August 2021. Sociodemographic data were collected through face-to-face interviews, and participants independently completed study measures in a self-report, paper-based format.

### Participants

The study included mothers of CP infants admitted to the NICU and mothers of healthy controls between September 2020 and August 2021. Due to potential variations and confusion stemming from differing medical treatment procedures in the NICU for various diseases, the study was limited to mothers of CP infants. Mothers with a history of psychiatric disorders or currently undergoing treatment and follow-up for such conditions were excluded from the study to prevent confounding factors in assessing mother–infant attachment in the context of our research. Also, mothers of CP infants who required readmission to the NICU for any reason before the 3-month check-up, as well as mothers of controls who were hospitalized or admitted to the NICU for any medical reason, were excluded from the study. At the 3-month follow-up of the infants, mothers were invited to complete the Maternal Attachment Inventory (MAI) and Parenting Stress Scale (PSS). The data on gestational week at birth, birth weight, delivery method, HD, IMVT, NIMVT, and BFT were collected from hospital records.

### Measures

**Sociodemographic Data Form:** The in-person interview form included the mother's age, education level, past and present psychiatric disorders, history of postpartum depression, and number of pregnancies and births.

**Parental Stress Scale:** This scale measures the stress levels among parents, featuring a single-dimensional structure of 18 items encompassing the parent, the parent–child relationship, and the child's characteristics.<sup>37</sup> This Likert-type measurement tool scores between 0 (not defining at all) and 4 (defining very well), with possible scores ranging from 0 to 72; higher scores signify increased parental stress.

**Maternal Attachment Inventory:** It is designed to evaluate the adaptation to the maternal role and the development of maternal identity.<sup>38</sup> This 26-item, 4-point Likert-type scale assesses responses as A - always (4 points), B - often (3 points), C - sometimes (2 points), and D - never (1 point). The cumulative score for all items was computed, with higher scores indicating stronger maternal attachment.

### Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM SPSS Corp.; Armonk, NY, USA). The Kolmogorov–Smirnov test and Shapiro–Wilk tests assessed the

**Table 1.** Characteristics of the Participants

	NICU n (%)	Controls n (%)	P
<b>Infants</b>			
Gender, female	26 (89.7)	25 (80.6)	.102*
Age (days), mean (SD)	94.17 (11.52)	93.50 (7.63)	.793**
Median (IQR)	94.0 (61.0)	93 (61.25)	
Birth weight	3024.00 (521.21)	3007.00 (466.95)	.877**
Median (IQR)	3030.0 (780.0)	2995.0 (865.0)	
Gestation week	37.90 (1.92)	38.20 (2.12)	.635**
Median (IQR)	38.0 (2.25)	38.0 (3.25)	
Nutrition type			
Breastfeeding	22	26	.380*
Formula	1	1	
Both	7	3	
<b>Mothers</b>			
Age, mean (SD)	27.57 (6.10)	27.63 (5.97)	.906**
Median (IQR)	27.0 (9.0)	26.5 (9.0)	
Education level	First-degree and lower 5 Second degree 9 High school 9 College and higher 7	First-degree and lower 1 Second degree 6 High school 12 College and higher 11	.284*
Gravida/parity	1.73 (0.74)/1.70 (0.75)	1.43 (0.68)/1.40 (0.62)	.084/.099**
Median (IQR)	2.0 (1.0)/2.0 (1.0)	1.0 (0.68)/1.0 (1.0)	

IQR, interquartile range; NICU, neonatal intensive care unit.

\*Chi-square test.

\*\*Mann-Whitney U-test.

normality of the quantitative data. Parametric methods were used for normally distributed variables, while non-parametric methods were applied to those not normally distributed. The Mann-Whitney U-test was used to compare independent groups, the Pearson chi-square test was used for categorical data, and the Spearman correlation test was used for correlated data. Analysis was conducted at a 95% CI, with *P*-values less than .05 considered statistically significant.

## Results

When comparing the infants' age (in days) and birth weight, there was no significant difference between the NICU group and controls (*P* = .877 and *P* = .793, respectively). Similarly, no significant difference was observed in gestation weeks (*P* = .635). Comparing the groups based on the mothers ages (*P* = .906), their educational statuses (*P* = .284), and the number of pregnancies (*P* = .084) and births (*P* = .099) revealed no significant difference between the groups. The characteristics of both infants and mothers are summarized in Table 1.

Table 2 displays the characteristics of NICU hospitalization for CP infants. The mean HD was 8.23 (2.27) days. The total mean mechanical ventilation (MV) time was 2.13 (1.57) hours for the NICU group. The mean BFT was recorded at 5.06 (2.66) hours.

**Table 2.** Neonatal Intensive Care Unit Hospitalization Characteristics

Characteristics	Mean (SD)
Hospitalization duration (days)	8.23 (2.27)
Invasive mechanic ventilation (hours)	0.40 (0.89)
Noninvasive mechanic ventilation (hours)	1.73 (0.98)
Total mechanic ventilation (hours)	2.13 (1.57)
Postpartum breastfeeding initiation time (hours)	5.06 (2.66)

Comparisons between the NICU mothers and controls regarding PSS and MAI scores are outlined in Table 3. The PSS scores for NICU mothers were significantly higher than that of the control group (*P* = .014), indicating greater stress levels. However, the groups had no significant difference in MAI scores (*P* = .141), suggesting similar maternal attachment scores.

Correlation analysis concerning maternal stress showed a positive correlation with IMVT (*r* = 0.47, *P* < .001) and HD (*r* = 0.57, *P* < .001) and a negative correlation with maternal attachment (*r* = -0.48, *P* < .001). In analyses related to maternal attachment, a negative correlation was found with IMVT (*r* = -0.39, *P* < .005), BFT (*r* = -0.53, *P* < .001), and HD (*r* = -0.45, *P* < .005). Extended IMVT was associated with a delayed BFT (*r* = 0.37, *P* < .005). Additionally, HD positively correlated with BFT (*r* = 0.7, *P* < .001). Correlation analysis data for these variables are provided in Table 4.

## Discussion

This study evaluated maternal stress levels and attachment scores in mothers of 3-month-old CP infants compared to controls, analyzing the relationships with IMVT, NIMVT, HD, BFT, maternal stress, and attachment. Results showed that extended IMVT and longer <HD were associated with increased maternal stress and decreased attachment scores. Furthermore, prolonged IMVT was linked to delayed BFT, which contributed to heightened maternal stress, reduced maternal attachment scores, and extended HD.

Neonatal intensive care unit mothers exhibited higher stress levels compared to controls, consistent with prior studies.<sup>23,39</sup> High NICU maternal depression and anxiety scores typically decrease after 2-4 months, while stress symptoms may persist in 2-4 months.<sup>16</sup> Although NICU hospitalization is known to affect mother-infant

**Table 3.** Comparison of Maternal Stress and Attachment Scores

	NICU Mothers	Controls	P
PSS [mean (SD)]	3.83 (0.69)	1.23 (0.23)	.014
Median (IQR)	2.5 (6.25)	1.0 (2.0)	
MAI [mean (SD)]	95.47 (1.03)	98.10 (0.70)	.141
Median (IQR)	99.0 (10.0)	99.0 (5.0)	

Mann–Whitney *U*-test.

IQR, interquartile range; MAI, Maternal Attachment Inventory; NICU, Neonatal Intensive Care Unit; PSS, Parental Stress Scale.

attachment negatively, previous research has indicated that maternal stress and depression can exacerbate the deterioration of this critical bond. Our research revealed elevated stress levels in NICU mothers compared to the control group. However, there was no significant difference in attachment scores at 3 months. The probable reason might be that we did not detect symptoms of maternal depression and anxiety, known to influence attachment, in our cohort. Another potential factor could be the timing of data collection, which occurred during the coronavirus disease 2019 pandemic. Neonatal intensive care unit mothers exhibited elevated stress levels during the pandemic.<sup>40</sup> However, a study comparing maternal stress levels before and during the pandemic among NICU mothers found no significant differences, suggesting that the increased stress levels in the control group might also reflect the pandemic's overall impact.<sup>41</sup>

Aligned with existing research, our study demonstrated that earlier BFT is associated with stronger mother–infant attachment. Furthermore, extended IMVT resulted in delayed BFT. Our findings also indicate that both extended IMVT and longer HD contribute to increased maternal stress, which in turn results in lower attachment scores among NICU mothers. Maternal stress in NICU mothers arises from factors such as perceived parental roles, the newborn's behavior, and appearance, as well as auditory and visual stimuli within the NICU environment.<sup>42–44</sup> Our findings support the notion that maternal stress can impact lactation and breastfeeding, potentially compromising the mother–infant attachment.<sup>45–47</sup>

Prioritizing the prevention of mother–infant separation at birth and involving parents as primary caregivers from the outset is essential.<sup>48</sup> Neonates admitted to the NICU for medical reasons undergo physical separation from their mothers, which

exacerbates maternal stress. A NICU stay for neonates impedes attachment behaviors crucial for strengthening mother–infant attachment, including touch, skin-to-skin contact, eye-to-eye contact, and soothing.<sup>49</sup> Reducing physical barriers in the NICU to enhance mother–infant interactions can help to alleviate maternal stress. Moreover, NICU mothers might fear harming their baby, which can restrict engagement in attachment behaviors like feeding, changing diapers, and physical affection, adversely affecting attachment.<sup>16</sup> Some interventions like skin-to-skin contact and kangaroo mother care practices in the NICU improve mood, reduce stress, create a stimulating and caregiving environment, and enhance breastfeeding and mother–infant attachment.<sup>50–52</sup> Parental stress perception during NICU stays is often influenced by the infant's appearance and behavior.<sup>53</sup> Invasive MV procedures, which may change an infant's appearance and behavior, could increase maternal stress. Thus, assessing maternal mental health and stress in NICU mothers is crucial, along with identifying and implementing interventions for at-risk mothers to reduce stress and improve mother–infant interactions.<sup>54,55</sup>

To our knowledge, this study is the first to evaluate the impact of NICU interventions on maternal stress and attachment. Despite its contributions, the study has several limitations. First, it relies on a small sample size and does not account for maternal depression and anxiety symptoms during NICU hospitalization or their influence on maternal attachment. Second, it lacks data on paternal stress, which can also affect mother–infant attachment. Third, the study does not evaluate postpartum depressive symptoms at 3 months, focusing exclusively on maternal stress and its impacts, thereby excluding consideration of depressive symptoms.

This study elucidates the complex dynamics of maternal stress and mother–infant attachment in the context of NICU hospitalization for CP, highlighting the pivotal role of IMVT, HD, and BFT on these outcomes. This research underlines the importance of holistic care in the NICU, recognizing the critical interplay between the infant's health, maternal mental health, and attachment. Given the implications of maternal stress and determinants of attachment, the implementation of interventions designed to alleviate stress and enhance positive mother–infant interactions within the NICU, early breastfeeding initiation, and their continuation thereafter is imperative.<sup>25,31,56–58</sup>

**Table 4.** Spearman's Rank Correlation Coefficients for Hospitalization Characteristics, Maternal Stress, and Attachment

Variables	PSS	MAI	IMVT	NIMVT	BFT	HD
PSS	1					
MAI	<b>-.475**</b>	1				
IMVT	<b>.467**</b>	<b>-.393*</b>	1			
NIMVT	.340	-.251	<b>.401*</b>	1		
BFT	.247	<b>-.529**</b>	<b>.365*</b>	.205	1	
HD	<b>.573**</b>	<b>-.445*</b>	.275	.153	<b>.699**</b>	1

Spearman correlation test.

BFT, breastfeeding initiation time; HD, NICU stay duration; IMVT, invasive mechanic ventilation time; MAI, Maternal Attachment Inventory; NIMVT, non-invasive mechanic ventilation time; PSS, Parental Stress Scale.

\**P* < .005.

\*\**P* < .001.

The bold values given in Table 4 shows the significant correlation with \**P* < .005. \*\**P* < .001.



**Availability of Data and Materials:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

**Ethics Committee Approval:** This study was approved by Noninvasive Clinical Researches Ethics Committee of Katip Çelebi University (Approval number: 898; Date: September 17, 2020).

**Informed Consent:** Informed consent was obtained from the participants who agreed to take part in the study.

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