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The Correlation of Postpartum Depression, Breastfeeding Prevalence, and Milk Production in Neonatal Intensive Care Unit (NICU)

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Abstract: *Breastfeeding is essential, particularly for newborns with severe health issues in the neonatal intensive care unit (NICU), where they frequently have to be separated from their mothers. Breastfeeding in the NICU requires a sufficient supply of breast milk from the mother, and this can be influenced by the mother's psychological condition. This study aimed to examine the correlation of postpartum depression with breast milk feeding prevalence and production in mothers with neonates in the NICU. This cross-sectional quantitative study included 42 mothers and infant dyads in the NICU in Malang, East Java, and was conducted between September and November 2024. The questionnaire of mothers and infants characteristics, the Edinburgh Postpartum Depression Scale, and the breast milk feeding prevalence observational sheet were used for the investigation. The correlation of postpartum depression with breast milk prevalence and breast milk production was measured by the Rank Spearman Test. Breast milk feeding prevalence was 64.3%, partial breast milk feeding was 31%, and formula milk was 4.8%. The proportion of mild and severe postpartum depression was 35.7%, and the rest of them were without depression (28.5%). Postpartum depression was not associated with the prevalence of breast milk feeding (p=0.140), but there was a significant correlation with breast milk production (p=0.04; r= -0.319). We found that greater postpartum depression was associated with lower breast milk production, but there was no correlation with the prevalence of breast milk feeding in the NICU. These findings highlight the importance of sufficient support for mothers with neonates in the NICU to produce enough breast milk supply.*

Keywords: breast milk feeding, breast milk production, Neonatal Intensive Care Unit (NICU), Neonates

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INTRODUCTION

Breast milk is an essential element for infant growth and development, as it provides the necessary nutrition, boosts the immune system, and offers protection against infections and allergies (Camacho-Morales et al., 2021). Optimal breastfeeding is especially important for reducing morbidity and mortality of ill preterm and full-term neonates (Sokou et al., 2022). Regarding preterm infants, breast milk prevents preterm infants from necrotizing enterocolitis (NEC), bronchopulmonary dysplasia (BPD), sepsis, retinopathy of prematurity (ROP), and neurocognitive impairment (Alves et al., 2016; Heller et al., 2021; Jiang & Jiang, 2022; Sokou et al., 2022). Despite these advantages, breast milk feeding in preterm newborns is far less likely than in term infants, and the prevalence of breast milk feeding in NICUs varies greatly between institutions and nations (Degaga et al., 2020). Research in one hospital in Indonesia revealed that 66.7% of infants in the NICU received breast milk nutrition (Juriyah et al., 2024).

Preterm infants are a high-risk population that may have serious respiratory, cardiovascular, or nervous system problems after birth, so admission to the NICU is necessary for many of them to receive more advanced than usual medical care (Sivanandan & Sankar, 2023; Sokou et al., 2022). Furthermore, Preterm infants have immature oral feeding skills due to limited sucking and swallowing reflexes

(Kamity et al., 2021; Sankar et al., 2022). Some term infants also require care in the NICU due to neurological, cardiac, or respiratory disorders (Sankar et al., 2022). This condition results in mother and infant separation, which can delay breastfeeding initiation because they miss the initial skin-to-skin contact (Sankar et al., 2022).

Early initiation of breastfeeding in NICU babies plays a significant role in sustaining breastfeeding after the baby leaves the hospital (Phukan et al., 2018; Tomlinson & Haiek, 2023). Therefore, the mother needs sufficient support to encourage enough milk supply, Even if the milk is given indirectly, like through an orogastric tube.

Adequate breast milk production is influenced by many factors, including the mother's psychological condition, such as postpartum depression (Suhana Yahya et al., 2021). Postpartum depression (PPD) (also known as peripartum depression) is a non-psychotic form of depression that manifests by prolonged feelings of sadness, anxiety, fatigue, and guilt that can develop within days or weeks after childbirth (Abdurehim et al., 2024; Dimcea et al., 2024; Henninger & Grimm, 2024). It is a form of depression that impacts approximately four in five women in very few days after childbirth and mostly remits by 10 days (Suryawanshi & Pajai, 2022).

Previous studies have shown that postpartum depression can reduce breast milk production, but research examining the correlation between maternal postpartum depression and breast milk feeding in NICU settings in Indonesia is largely unknown and needs to be further investigated. Existing studies tend to focus on mothers of healthy babies, while mothers of babies in the NICU often face more complex situations. Therefore, this study aims to explore the correlation between maternal postpartum depression and the prevalence of breast milk feeding and breast milk production in the NICU, with the hope of providing insights to improve breastfeeding prevalence for NICU babies.

METHODS

A cross-sectional observational study was conducted from September to November 2024 at a tertiary referral regional hospital in Malang City, East Java, Indonesia. The NICU had 429 admissions in 2024 and admits approximately 36 neonates per month. Every procedure was carried out in compliance with the guidelines provided in the World Medical Association's Declaration of Helsinki and approved by the Dr. Saiful Anwar Ethics Committee, no. 400/193/K.3/102.7/2024, for studies involving humans.

All participants were provided with an explanation of the study aims and gave their voluntary consent to participate by completing the consent section within the questionnaire. Mothers who visited the NICU were asked to take part in the study, which occurred daily between 11:00 AM and 1:00 PM. The study included 44 mothers recruited from the NICU of Dr. Saiful Anwar Hospital who had neonates treated in the neonatal intensive care unit (NICU).

Mothers who had babies who were treated in the NICU for at least 3 days and are willing to participate as respondents are invited to this research. Mothers with chronic conditions that prevented them from breastfeeding their infant, such as HIV infection, were excluded from this study.

On the day of their visits to the NICU, the socio-demographic characteristics of mothers and infants and the Edinburgh Postnatal Depression Scale (EPDS) questionnaire were completed by mothers with the assistance of the enumerator. Researchers maintain data confidentiality by limiting data access only to researchers and members of the research team.

Maternal demographic data included the mother's age, formal education level, occupation, family type and income, routine ANC, mode of delivery, whether lives with her husband during the postnatal period, maternal lactation experience, and gestational age. Infant characteristics data were collected from the medical records, consisting of gender and birth weight. The type of feeding in the NICU consists of breastmilk feeding (BMF) and partial breastfeeding (PBF), and the formula was collected from the nurse observational sheet. Daily breast milk production data was obtained from parental reports.

The ten items on the Edinburgh Postnatal Depression Scale evaluate mood, pleasure, self-blame, anxiety, fear, insomnia, coping skills, sadness, crying, and self-harm. A four-point rating system is used

for each item with scores of 0 (never), 1 (occasionally), 2 (often), and 3 (always), based on the severity of the symptoms. The total scores across the ten items are categorized as follows: 0–9 indicates no postpartum depression, 10–13 indicates mild postpartum depression, and a score of ≥ 14 designates severe postpartum depression (Jiang & Jiang, 2022). The Indonesian version of this questionnaire has been tested for validity and reliability with a Cronbach's alpha coefficient of 0.86, which indicates good reliability.

SPSS Statistics 26 was used for data analysis, with p-values < 0.05 considered statistically significant. Descriptive statistics uses counts and percentages to summarize categorical data. The Spearman rank test was used to assess the relationship between levels of postpartum depression and breast milk feeding prevalence in the NICU. We also investigated the relationship between levels of postpartum depression and breast milk production.

RESULTS

Table 1 displays the socioeconomic and demographic information of the women and infants taking part in the study.

Table 1. Parental and infant characteristics

Variable		n	%	mean	SD
Maternal Age	< 35 years old	34	81	30	5.9
	> 35 years old	8	19		
Maternal educational level	Primary education	15	35.71		
	Upper secondary education	13	30.95		
	Higher education	14	33.33		
Maternal occupation	Working	10	23.8		
	Unemployed	32	76.2		
Family type	Nuclear	26	61.9		
	extended	16	38.1		
Family income (Rp)	>3 million	24	57.1		
	<3 million	18	42.9		
Mode of Delivery	vaginal	11	26.2		
	Cesarean	31	73.8		
Gestational week	< 28	3	7.1	35	4.5
	28-31	7	16.7		
	32-37	20	47.7		
	≥37	12	28.6		
Live with husband during the perinatal period	No	3	7.1		
	Yes	39	92.9		
Infant gender	Male	25	59.5		
	Female	17	40.5		
Weight at birth (g)	<1000	2	4.8	2195	809.7
	1000-1500	6	14.3		
	1501-2500	19	45.2		
	>2500	15	35.7		
Routine Ante Natal care	Yes	32	76.2		
	No	10	23.8		
Breastfeeding experience	Yes	33	78.6		
	No	9	21.4		
Type of feeding in NICU	BMF	27	64.3		
	PBF	13	31		
	Formula (F)	2	4.8		

A total of 42 postpartum women participated in the study, including 28.6% with full-term deliveries and 71.4% with preterm deliveries. Of these, 16.7% were very preterm (between 28 and 31 weeks of pregnancy), 47.7% were moderate to late preterm (between 32 and 36 weeks of pregnancy), and 7.1%

were extremely preterm (births before 28 weeks of pregnancy). There were 59.5% male and 40.5% female infants. Among the infants, the largest group (45.2%) had a birth weight of 1501-2500 grams. Those with a birth weight of less than 1000 grams accounted for 4.8%, those between 1000 and 1500 grams were 14.3%, and those above 2500 grams represented 35.7%.

Postpartum depression was examined using the Edinburgh Postnatal Depression Scale, revealing an average score of 12.07 for mothers with infants admitted to the NICU, indicating mild depression. Depression scores were also categorized based on severity, with the majority of mothers experiencing mild and severe depression (35.7%). Data on breast milk production and infant nutrition in the NICU were obtained through interviews with mothers and from NICU nurse observation sheets. The average amount of breast milk sent to the NICU by mothers was 100 ml per day, with the highest volume reaching 300 ml per day. Furthermore, the majority of infants in the NICU received breast milk exclusively (64.3%), some received a combination of breast milk and formula (31%), and only 4.8% received formula milk. This result is summarized in Table 2.

Table 2. Level of Depression of mothers and nutrition of infants in NICU

Variable		N (%)	Mean	SD
Depression level and Score	No depression	12 (28.6)	12.7	5.1
	Mild depression	15 (35.7)		
	Severe depression	15 (35.7)		
Nutrition in NICU	breastmilk feeding (BMF)	27 (64.3)		
	partial breastfeeding (PBF)	13 (31)		
	Formula (FM)	2 (4.8)		
Volume of breast milk (median, min-max)		100	100	0-300

The study was conducted to analyze the correlation of maternal postpartum depression using the Edinburgh Postnatal Depression Scale and breast milk feeding prevalence in the NICU. This relationship was assessed through the Spearman test, with the result analysis did not yield statistically significant results ($p > 0.005$) (Table 3).

Table 3. Correlation of maternal postpartum depression level and the prevalence of breastfeeding in NICU

		FM		PBF		BMF		Sig (p)	r value
		n	%	n	%	n	%		
Depression level	**No depression**	1	8	2	17	9	75		
	mild depression	0	0	4	27	11	73	0,140	-0,231
	Severe depression	1	6.6	7	46.7	7	46.7		

Additional Spearman test analyses were performed to explore the correlation between maternal postpartum depression and breast milk production Table 4. The analysis revealed statistically significant findings ($p < 0.05$). The results of this study indicate that higher depression scores are significantly correlated with a decrease in breast milk production, with a moderate to strong strength of the relationship.

Table 4. Correlation of maternal postpartum depression and Milk Production

Variable	Mean (SD)	SD	p value	r value
Score of depression	12.07	5.1		
Volume of breast milk (median, min-max)	100	0-300	0.04	-0.319

DISCUSSIONS

The results of this study revealed that most babies treated in the NICU were premature, which can affect postpartum depression experienced by mothers (Jiang & Jiang, 2022). The birth of preterm infants can have a significant emotional effect on mothers since the necessity of intensive care in the NICU sometimes results in higher anxiety and a higher risk of postpartum depression (Worrall et al., 2023). The stress of caring for an infant who requires such specialized attention can be overwhelming, forcing mothers to adjust to new, often challenging circumstances.

In this study, most of the mothers were less than 35 years old (81%) and, as housewives (76.2%), had attended primary education (35.7%). This suggests that for a large proportion of the participants, there exist socio-economic characteristics that may influence their levels of stress and anxiety following childbirth, and those characteristics potentially contribute to the risk of postpartum depression. Prior studies found an association between decreased postpartum depression risk and professional or technical jobs. Employment, including full-time employment, was also associated with this reduced level of risk. In the study, a greatly reduced postpartum depression risk was reported for women who had professional or technical jobs (Izvoranu et al., 2024). These findings suggest that maternal education and occupation may influence the risk of postpartum depression, with lower education levels and certain occupational factors potentially increasing the risk. However, the relationship between these factors and postpartum depression is complex and may be influenced by various socio-economic and cultural factors.

In this study, the majority of mothers had nuclear families (61.9%) with a household income of more than 3 million rupiahs, above the regional minimum wage (57.1%). This financial stability likely played a role in their ability to access healthcare services and receive support during the breastfeeding process. Research shows that mothers with better access to healthcare and stronger socio-economic support are better equipped to handle the challenges of the postpartum period and are at a lower risk of developing depression (Seymour et al., 2015). They also had breastfeeding experience (78.6%), which may have helped them feel more confident in their ability to care for their infants. Having prior experience with breastfeeding is often linked to higher self-assurance, which can ease the stress associated with feeding a newborn. This sense of preparedness can be vital in helping mothers navigate the challenges of new motherhood.

Additionally, the majority of women (more than 92.9%) lived with their husbands during the perinatal period and underwent antenatal care (76.2%). This reflects emotional and practical support from the husband that was significantly associated with lower levels of postpartum depression. The husband's involvement served as a key protective factor for maternal mental health (Tani & Castagna, 2017).

The absence of a significant relationship between postpartum depression (PPD) and the type of nutrition—whether exclusive breast milk, a combination of breast milk and formula, or exclusive formula—can be explained by several factors. Mothers with infants in the NICU often face immense challenges, especially the stress of their baby's hospitalization, which can significantly affect both their mental well-being and their breastfeeding practices. Mothers of preterm infants in the NICU experience heightened levels of stress and anxiety, which can interfere with their ability to breastfeed, regardless of the type of nutrition provided (Cristóbal-Cañadas et al., 2021).

Moreover, the NICU environment itself can be a major source of stress and anxiety for mothers. This environment, with its constant medical interventions and concerns about their infant's health, can influence both their feeding choices and mental health. The NICU environment can create considerable stress for parents, potentially impacting not only their mental health but also their decisions around infant feeding (Erbaba & Pinar, 2021).

The correlation found between postpartum depression and the volume of expressed breast milk reflects well-established findings in existing literature, which emphasize the challenges that many mothers face when trying to produce enough milk during the postpartum period. The mothers who experienced depressive symptoms were more likely to struggle with breastfeeding, particularly with issues related to milk expression (Zanardo et al., 2016). One physiological explanation suggested to

explain these interactions is that psychological stress might interfere with the production of oxytocin, a hormone crucial in milk ejection during breastfeeding. Ongoing milk ejection impairment could cause incomplete emptying of the breast during every breast milk expression, therefore reducing milk production. Maternal distress may also result in higher levels of blood cortisol and impaired insulin sensitivity, which are linked to decreased milk production (Nagel et al., 2022).

Additionally, the correlation between psychological distress and breastfeeding is likely to be bidirectional (Nagel et al., 2022). A study showed that mothers who were able to express breast milk had lower depression scores compared to those who were not able to, suggesting that the process of expressing breast milk itself may provide the pleasure/reward and calming effects of oxytocin on the mother and help improve maternal mental health (Hollen et al., 2019). This suggests interventions to support lactation and breastfeeding goals in women with high levels of psychological distress would be beneficial for both maternal and infant well-being. Furthermore, several factors that significantly predicted early postpartum depression in mothers of preterm infants, such as the type of delivery, the infant's health status, and the level of support received from medical staff, were identified (Martin-Anderson & Lee, 2015). These elements may also play a role in influencing both the volume of milk expressed and the mother's emotional well-being, underlining the complex relationship between breastfeeding, milk expression, and mental health during the postpartum period.

CONCLUSION

In conclusion, this study highlights the complex relationship between postpartum depression and breast milk-feeding prevalence among mothers of infants in the NICU. While no significant link was found between postpartum depression and the type of nutrition (exclusive breast milk, a combination of breast milk and formula, or formula), the volume of expressed breast milk was strongly associated with depression levels. This suggests that mothers with higher depression scores faced greater difficulties with breast milk production, supporting previous research that shows how emotional distress can complicate breastfeeding. These findings emphasize the need for holistic support that addresses both the emotional and physical challenges mothers face, particularly those with preterm infants in the NICU.

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AUTHOR CONTRIBUTION

MIS contributed to the drafting, research permit, ethical testing, and collection of data. SA and REK contributed to supervising the research, writing manuscripts, and revising.

ETHICAL APPROVAL AND CONSENT

This research has been tested ethically based on the Ethical Clearance Dr. Saiful Anwar Ethics Committee, no. 400/193/K.3/102.7/2024.

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This study received no external funding.

CONFLICT OF INTEREST

The authors hereby declare that there’s no conflict of interest in this study, either to any institutions or individuals

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are not publicly available due to privacy or ethical restrictions.

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